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Frankfurter, Felix and Goldmark,

Case for the shorter work day:
Supplemental brief for defendant
in error upon re-argument.

Case for the shorter work day

OCTOBER TERM, 1916.

NO. 38.

FRANK O. BUNTING.

Plaintiff in Error,

vs.

THE STATE OF OREGON.

Defendant in Error.

FELIX FRANKFURTER,
Of Counsel for the State of Oregon.

Assisted by

JOSEPHINE GOLDMARK,
Publication Secretary,
National Consumers' League.

Reprinted by National Consumers' League,
289 Fourth Avenue, New York City.

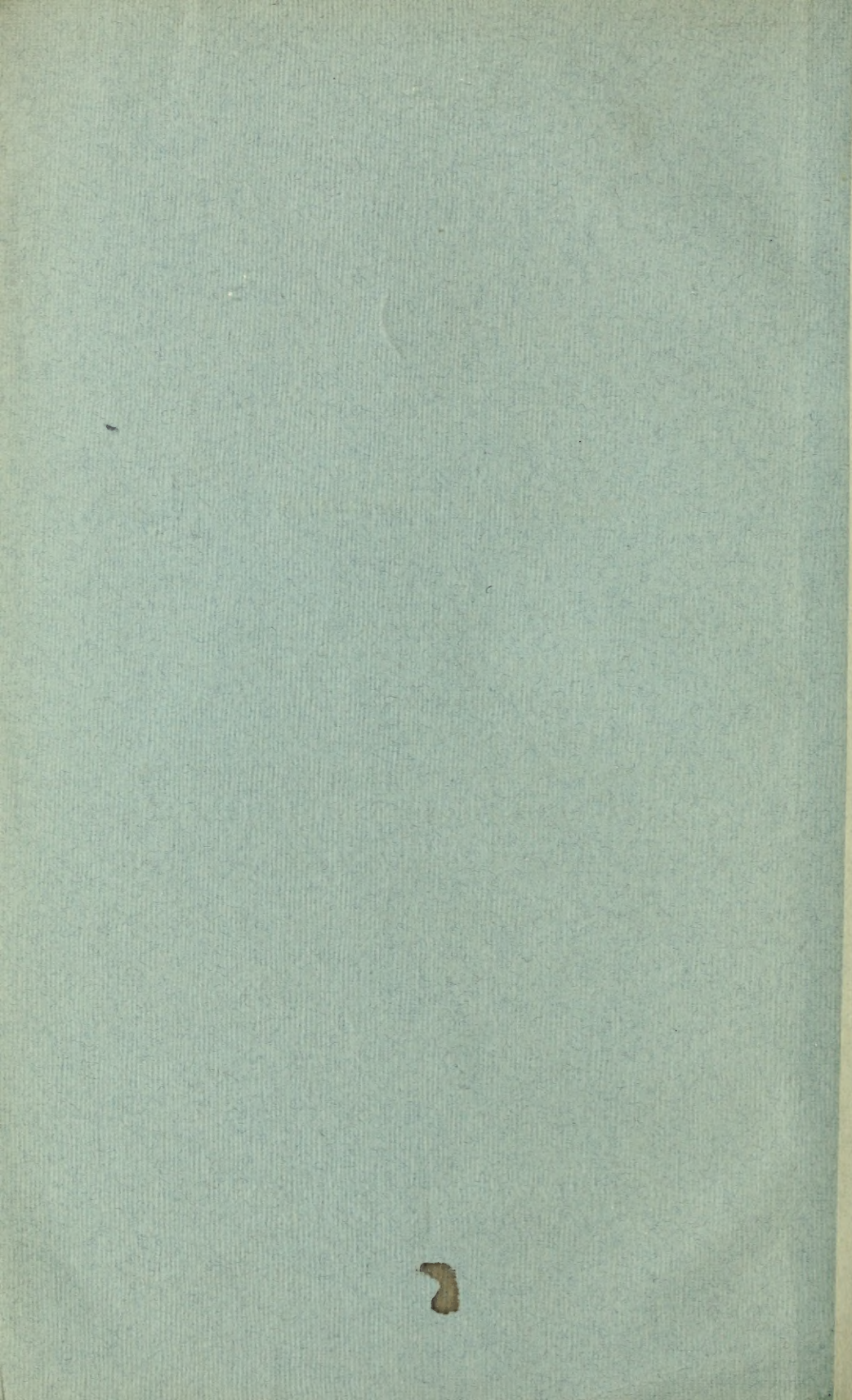


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Supreme Court of the United States,

OCTOBER TERM, 1916.

No. 38.

FRANKLIN O. BUNTING,
Plaintiff in Error,

vs.

THE STATE OF OREGON,
Defendant in Error.

Supplemental Brief of Defendant in Error upon Re-argument.

I. THE EVILS OF LONG HOURS.

Since the first argument of *Bunting vs. Oregon* in April, 1916, the most notable contributions to the world's experience with industrial fatigue and its consequences, have come from Great Britain.

The war has forced into national prominence the condition of the workers in munition plants and in other factories manufacturing war supplies. It has come to be recognized that upon their output and efficiency depends, in the last resort, the national defense. It has therefore been, as never before, a matter of national concern to study and conserve the working capacity of these industrial workers.

Three separate but co-operating agencies are now at work in this field; the Health of Munition Workers Committee, Sir George Newman, Chairman, appointed by the British Ministry of Munitions; a committee of the British Association for the Advancement of Science acting in conjunction with the Research Committee of the National Health Insurance; and special investigations carried on for the British Home Office by Professor A. F. Stanley Kent of the University of Bristol.

The results of these investigations published to date confirm and amplify the facts and opinions embodied in the briefs submitted by the State of Oregon in April, 1916.

These new studies and observations record, as it were, controlled experiments. The output of workers in munition plants, in wrapping lint and surgical dressings is not a matter of conjecture. Hour by hour their operations have been scrutinized and recorded; the results of the short day and of overtime work have been compared. Scientific examinations of the workers have been made before and after the day's work, during overtime and under reduced hours.

Satisfactory means of gauging and recording the general health and fitness of workers have always been difficult to find. Various new tests of the acuity of sight and hearing have been carried on during some weeks by Professor Kent, and have yielded valuable proof of the decline in general fitness of workers after the introduction of overtime and their improvement under shorter hours. These tests confirm the more general observations of the Health of Munition Workers Committee re-

garding the "staleness" of workers after persistent long hours.

Another index of industrial fatigue is found in the sickness rate of the workers. For instance, a well-known and typical munition factory had 14,000 employees in July, 1914, and 36,000 employees in March, 1915. The percentage of sickness in July, 1914, was 2.9; in the first 3 months of 1915 it exceeded 4 per cent. Later inquiry showed that in two departments the sickness rate among men on overtime was 5.5, as against 3.7 among those on double shifts.

A. INJURIES TO HEALTH.

British Ministry of Munitions. Health of Munition Workers Committee. SIR GEORGE NEWMAN, M. D., Chairman. Memorandum No. 7. Industrial Fatigue and Its Causes. London, 1916.

(d) Sickness, Lost Time and "Staleness".

13.—The accumulated results of fatigue are damaging to general health, and they will be reflected in the sickness returns and in the returns of lost time. Many problems arise here which cannot be discussed in detail, and they are complicated by the influence of other factors which will be discussed in the following section. Without complete analysis of other variables, sickness returns will be only an indirect guide in the study of fatigue as such.

14.—Reference must be made here, however, to a pronounced and common symptom of industrial fatigue, which appears to be the reflection in the workman's general health and "spirits" of the results of accumulated nervous fatigue rather than a direct or measurable sign of it. At the present time in very many munition factories the complaint is made by workers, and not least by the most intelligent and willing of them, that they are feeling "done up" or "fair whacked," to use local phrases, and the evidence shows that this state of "staleness" is becoming increasingly common and obvious. By

experienced managers and medical officers this condition of staleness is attributed almost wholly to persistent long hours and the deprivation of weekly rest. It has grave accompaniments, which paradoxically appear not only in a state of lethargy and indifference, but also in a craving for change and excitement. No doubt the restlessness of the condition must often predispose also to indulgence in the alleviations given by alcohol. At all points the state is apt to set up a vicious circle in which the very need for change and rest prevents the proper use of such chances of rest as are given.

The following is typical of many reports made to the Committee:

"The works manager who showed me round had worked 361 days out of 365, and looked worn. He would welcome Sunday holidays. A skilled tool-maker had had eight days' holidays—including one for a funeral—since the war began (14 months). He complained of the strain on his nerves."

The officials of a very large Trade Union said that overtime "was generally considered to be excessive. The most skilled workmen were becoming nervy."

Proper attention earlier in the war to the need for weekly rest would have prevented a large part of the diminished capacity of this kind that has been allowed to appear, and would have averted much costly and wasteful expenditure upon imperfect work. (Pages 9-10.)

16.—In the rapid enlargement and organisation of munition factories in this country there has been, and is, the most urgent need for the application of the results of experience scientifically acquired. Upon a sudden national emergency the accumulation of fatigue and its results in workers might well be temporarily disregarded, but now, though the special need persists, the race is to be a long one, and a failure to conserve the maximum efficiency of the workers must be disadvantageous. Misguided efforts to stimulate workers to feverish activity in the supposed interests of the country are likely to be as damaging to the desired result as the cheers of partisans would be if they encouraged a long-distance runner to a futile sprint early in his race.

Even during the urgent claims of a war the problem must always be to obtain the maximum output from the individual worker which is compatible with the maintenance of his health. In war time the workmen will be willing, as they are showing in so many directions, to forego comfort and to work nearer the margin of accumulating fatigue than in time of peace, but the country cannot afford the extravagance of paying for work done during incapacity from fatigue just because so many hours are spent upon it,* or the further extravagance of urging armies of workmen towards relative incapacity by neglect of physiological law.

The Committee have found many isolated instances in which the onset of industrial fatigue has been avoided by intelligent observation of the output and of the returns of sickness and of lost time, and by prompt initiative in adapting the hours of work to physiological need; but these instances are exceptional. Taking the country as a whole, the Committee are bound to record their impression that the munition workers in general have been allowed to reach a state of reduced efficiency and lowered health which might have been avoided without reduction of output by attention to the details of daily and weekly rests. (Page 10.)

Examples may be given of the value of intelligent management:

At another large munitions factory men engaged in the heavy work of moulding are required by the management to rest 15 minutes in every hour of work. The manager was satisfied that this was an arrangement good for the men and for the output. But the men objected to this long spell of rest in each hour because the work was piece-work, and they thought the production would be lessened by it. The manager accordingly found it necessary to set a foreman to watch and to make the hourly rest compulsory. When this was done the output per hour was found to be actually increased.

At another munitions factory the Committee learnt that the manager had given a break of 15 minutes daily

* On the question of Sunday work by exhausted men, one foreman said he did not believe in "a holiday on double pay." Another remarked that Sunday work gave "six days' output for seven days' work on eight days' pay."

at 11 a. m. to girls engaged in sedentary work of a monotonous repetitive kind. During the break the girls had recreation in the open air. In spite of this deduction from their working hours of the time so spent, the output per day was increased. . . .

Our national experience in modern industry is longer than that of any other people. It has shown clearly enough that false ideas of economic gain, blind to physiological law, must lead, as they led through the 19th century, to vast national loss and suffering. It is certain that unless our industrial life is to be guided in the future by the application of physiological science to the details of its management, it cannot hope to maintain its position hereafter among some of its foreign rivals, who already in that respect have gained a present advantage. (Page 11.)

British Ministry of Munitions. Health of Munition Workers Committee. SIR GEORGE NEWMAN, M. D., Chairman. Memorandum No. 10. Sickness and Injury. London, 1916.

1.—The effect of industrial occupation upon the health of the worker has been a subject of medical investigation since the seventeenth century. Early in the nineteenth century similar inquiries were instituted in England, and in 1831 Thackrah showed that the environment and conditions of factory life, or the mental and physical strain entailed, were associated with exceptional disablement, disease or mortality among the persons employed. Numerous Commissions have been appointed by the Government to ascertain more precisely the exact causes of such effects, and these have considered successively the general circumstances of the worker, the injurious influences of the factory system, the special conditions of certain occupations, the risks incurred in the use of machinery, and the results arising among those employed in dangerous trades. Thus has been accumulated a vast body of medical experience, growing with the growth of industry and with the increase of our knowledge of the causes of disease. Concurrently with the appearance of evidence of a medical and social character further light has been thrown upon the subject by actuaries, insurance

agents and statisticians. As long ago as 1853, Finlaison, the actuary of the National Debt, said that "the real practical difference in the distribution of sickness seems to turn upon the amount of expenditure of physical force," and fifty years later, in 1903, Watson, who had studied the subject from an actuarial point of view, wrote that "the proportion of members sick during any year varies with occupation." Again, the experience of insurance authorities confirms the same view. The Report on National Health Insurance for 1913-1914 states that "in many cases the rate of sickness is affected by occupations or by the conditions incidental to particular occupations." Lastly, there is the incontrovertible evidence furnished by the Bills of Mortality steadily accumulating in proof as the years pass. The Decennial Reports of the Registrar General demonstrate that certain occupations have a high comparative mortality, that this mortality is due to well-defined and preventable diseases, that the occupation may exert a greater influence on mortality than the aggregation of population and its associated conditions, and that occupational mortality is affected by the age incidence of the worker.

Sickness and Its Causes.

2.—Sickness due, directly or indirectly, to industrial occupation takes various forms and degrees, from a passing headache to serious organic disease of fatal issue. The lungs, the heart, the digestive organs, the nervous system, the muscular system—each or all may be affected, with results harmful both to industrial efficiency and output and to personal health and expectation of life. Moreover, it must be remembered that an undue proportion of sickness in any group of workers usually represents, among those not actually sick, lessened vigour and activity, which cannot fail to reduce output. Disabling conditions or influences which injure some have a tendency to mark all. It is desirable that employers and their workpeople should have a general appreciation of these injurious conditions in order to be on the outlook to guard against them or mitigate their evil effect. Speaking generally, attention should be given to the following points:

(1) Excessively long hours of work, particularly by night, if continued, produce fatigue, irritation and sickness. "You will find," wrote Sir James Paget, "that fatigue has a larger share in the promotion or permission of disease than any other single casual condition you can name." (Pages 3-4.)

Indications of Sickness.

3.—The *Indications of Sickness* in a factory fall into four groups of facts, which come before the management. First, there is absence, broken time, irregular time-keeping, or diminished output of the individual worker. . . . Secondly, there are the ordinary signs of ill-health, the listless or jaded worker, lassitude, headache, faintness, cough, vomiting, etc. Thirdly, there is the sickness register which should be kept in all well-organized factories. . . . Lastly, there are the death certificates, few in number, but extremely important as indications of the health of the workers as a whole. In the past, when the supply of labour was plentiful, the necessity for a study of the influences which affect human efficiency may have escaped recognition, but to-day, when skilled labour is scarce, the necessity is obvious. To conserve energy and efficiency is *cacteris paribus* the way to improve output.

4.—The subject of the Sickness Rate is perhaps the most important of these four signs of a significant amount of ill-health among employees, and it may be well to give an example in illustration thereof. A well-known and typical munition works had some 14,000 employees in July, 1914. After the outbreak of war the number rapidly increased; by the end of the year it had doubled, and in March, 1915, the number employed was upwards of 36,000. The percentage of sickness in July was 2.9; in December it was 2.4; and in the first quarter of 1915 it exceeded 4 per cent., to some extent probably owing to seasonal causes. During the same period the accident rate also showed some increase. A recent enquiry showed that in two departments the sickness rate among men on overtime was 5.5 as against 3.7 among those on double shifts. In one of these departments among a body of nearly 1,000 men working overtime the sickness rate reached 8 per cent., the leading causes being probably

the greater age of the workers, a fifteen-hour day, frequent Sunday work and the special strain of the work. The medical officer of the works attributed the increase of sickness and injury in the factory as a whole to (a) a large increase of employees (many new hands), (b) overtime, with its attendant fatigue, and (c) night work. The principal forms which the sickness took in order of importance were medically reported as influenza, digestive diseases, bronchitis and bronchial catarrh, nasopharyngeal catarrh, rheumatism, nervous diseases and neuralgia, tonsillitis, myalgia, and skin diseases. In another large works the sickness rate had risen to 4 per cent., and was still rising, and at a third it was 7 per cent. (Pages 4-5.)

British Ministry of Munitions. Health of Munition Workers Committee. SIR GEORGE NEWMAN, M. D., Chairman. Memorandum No. 5. Hours of Work. London, 1916.

In the preparation of this Memorandum the Committee have necessarily been influenced by considerations of what is immediately practicable regarding the health of the worker in relation to a maximum output, in view of the exceptional conditions entailed by the War. The limits of hours which they propose are based on the expectation that the War will be of long duration, and are such as they think can reasonably be continued over a protracted period. Many divergent factors have had to be weighed one against another and a number of the suggestions made are the resultant of a balance of considerations. The Memorandum is directly concerned only with the hours of employment of workers engaged on the production of those munitions of war for which the Ministry are directly responsible; it is not, for example, concerned with the hours in the shipbuilding or textile trades. (Page 3.)

An increased number of hours may be obtained either by overtime (by which is meant a lengthening of the normal daily hours of work) or by a system of shifts. The Committee greatly prefer the latter alternative, but recognize that, for reasons which will be discussed later, it is impracticable to establish shifts universally.

Overtime.

2. Overtime is commonly justified on the ground that no other arrangement is possible owing to a dearth of workers and to the difficulties of increasing plant, and it is contended that, though the output per hour may not be maintained, the system does result in increased production. It should be noted that as the most highly skilled workers (tool and gauge makers, tool-setters, etc.) are the most difficult to obtain, they have been most generally employed on overtime, and have frequently had to work exceedingly long hours. At one time cases of men working as much as 90 hours per week were common; more recently there has been a tendency to reduce hours, but even so weekly totals of 70 to 80 hours are still frequent. Some overtime amongst this class is no doubt inevitable, but the Committee are satisfied that hours such as these cannot be worked with impunity, and they most strongly urge that every effort should be made, either by "dilution" of labour or otherwise, to extend the shift system to this branch of the industry as rapidly as possible.

3. The objections to overtime may be briefly stated as follows:

(1) It is liable to impose too severe a strain on the workers. Many witnesses assert that while for an emergency overtime is effective, after a period the rate of production tends to decrease and the extra hours to produce little or no additional output. Moreover the quality of the output may be adversely affected during the whole period of work and not only during the hours of overtime.

(2) It frequently results in a large amount of lost time. In part this is to be attributed to the workers becoming exhausted and taking a rest, and also to sickness, noticeable chiefly amongst the older men and those of weak constitution.

(3) It imposes a very serious strain upon the management, the executive staff, and the foreman, both on account of the actual length of the hours worked and the increased worry and anxiety to maintain output and

quality of work. These men cannot take days off duty like the ordinary workers.

(4) It is liable to curtail unduly the period of rest and sleep available for those who have to travel long distances to and from their work, a matter of special importance in the case of young persons.

(5) The fatigue entailed increases the temptation to men to indulge in the consumption of alcohol; they are too tired to eat, and seek a stimulant.

4.—The Committee have not found that as yet the strain of long hours has caused any serious breakdown among workers, though many general statements indicative of fatigue have been received by the Committee; in particular there is medical evidence to the effect that the long hours are beginning to make themselves felt upon the older men and upon those who suffer from physical infirmity. It is noticeable, too, that there is a general tendency towards a reduction of hours. There is good reason for believing that the increased pay, and the better food that workers have been able to enjoy in consequence, have helped to counteract the strain of long hours, and there is little doubt, too, that both men and women have been stimulated to make a special effort by an appreciation of the national importance of their work. (Pages 3-4.)

It would be a mistake, however, to depend too largely upon the operation of influences of this kind, or to hope that they can continue indefinitely to be effective against fatigue. The Committee are satisfied that if men are asked to work for 15 hours a day for weeks and months on end (as in the case now in certain areas) one of two results must follow. Either the health of the workers will break down or they will not work at full pressure. In either case output must suffer. It must be remembered, moreover, that the problem to be considered is not so much whether the workers have been able to withstand the strain of extra hours up to the present, as whether they are likely to continue to withstand it under similar conditions for a further protracted period. (Page 4.)

Second Interim Report of an Investigation of Industrial Fatigue by Physiological Methods. A. F. STANLEY KENT, M. A., D.Sc. (Oxon). *Henry Overton Wills Professor of Physiology in the University of Bristol.*

London, 1916.

Fatigue as dealt with in these pages and as indicated by the tests described is taken to mean a diminished efficiency of the organism occurring after labour and partly dependent upon it. . . .

The practical bearing of this is on the question of overtime. It has been thought that the simplest method of increasing output in times of stress is to increase the number of hours in the working day. But extra hours must necessarily be added at the end of a day's work, and the result will vary according to the previous condition of the worker. Should the work of the ordinary day have been so light that no fatigue is evident at the end of it, the workers will be comparatively fresh when they start upon the period of overtime and will suffer little. If, however, the previous work has been severe, they will already be fagged and jaded, and the extra labour will produce a greater effect.

Results obtained recently show further that overtime has an effect which is not confined strictly to the day on which it is worked. The worker is in a less favourable condition to resist fatigue after an ordinary day's work, followed by a night's rest, than before, and the effect of an overtime day is correspondingly greater. Two or more overtime days produce a proportionately greater lowering of efficiency, and the effect is more pronounced if the overtime days are consecutive than if they are separated by days of normal length. Finally, an overtime day introduced towards the end of the week is more harmful than one worked nearer its beginning. (Page 7.)

Seven factories in all have been visited. Investigations were carried on at one of these for a period of three and a half months, shorter periods being devoted to most of the others. . . . The first of these employed about 2,000 hands and was engaged principally in the manufacture of surgical dressings for the army in the field. . . . The second was an engineering works

employing about 600 men, besides many women. (Page 3.)

The tests described were carried out in the morning before the examinee commenced work and again in the evening when the day's task had been completed. . . .

Test No. 1. A—Letters. B—Colours.

Complex Reaction Time. Letter or Colour Test.

The test was made as in former experiments by requiring the examinee to depress a particular key which, at the same time that its movement was recorded on a moving drum, closed a circuit and caused a shutter to fall, thus exposing one of a series of letters, or, in the case of the colour test, a particular colour. The examinee was required to recognize the letter or colour exposed, to select from six keys in front of him the one bearing a similar letter or colour to that exposed and to depress it. The result . . . was to produce a second mark upon the drum. The distance between the two marks . . . was shorter or longer according to the time taken by the examinee to recognize the letter (or colour) exposed, to select the appropriate key and to depress it. A chronograph, marking fractions of a second, allowed the time corresponding to this distance to be measured.
. . . .

Test No. 2. Acuity of Hearing.

The test was made by determining the greatest distance at which the examinee could hear the tick of a given watch.

Test No. 3. Acuity of Sight.

The test was made by determining the greatest distance at which the examinee could identify letters of standard size stencilled upon cards. (Pages 7-8.)

GENERAL DESCRIPTION OF CHARTS.

In order to make the curves more easily understood the differences have been calculated as follows:

In the Reaction Time Test the differences are

M—E

(Morning value minus evening value)

If the evening value has been increased by fatigue the difference will be negative, and the curve will fall below the zero line.

In the tests of Acuity of Sight and Hearing the differences are

E—M

If the evening value has been diminished by fatigue the difference will be negative, and the curve will fall below the zero line. . . .

The curves show a fall of the line, indicating the development of fatigue, on days on which work was performed. The Tables give the actual readings from which the curves were made.* (Page 9.)

In Chart No. 3, the results are shown of a series of tests of the acuity of sight. The period covered in the six days from October 25th to October 30th, inclusive. The conditions were similar to those which obtained in the former experiment, values above the base line representing greater acuity in the evening, and vice versa. The differences are, however, given in centimetres, and indicate differences in the distance at which standard letters could be identified. (Page 11.)

Table (Figures for No. 3)

Fatigue=M—E.

	—	M	T	W	Th	F	S
(Sight)	E	520	380	326	313	362	369
	M	373	470	411	368	476	433
	E.—M.	147	—90	—85	—55	—114	—64 (Differences)

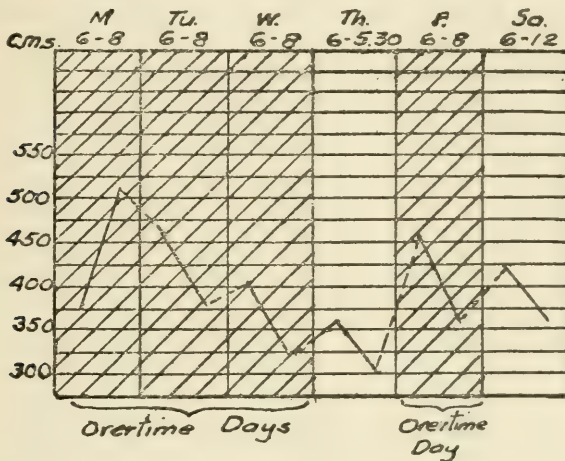
* The course of the curve is determined neither by the development of fatigue nor by recovery alone, but by the interaction of these two processes.

CHART No. 4.

ACUITY OF SIGHT.

A fall of the curve indicates the development of fatigue.

The curve is constructed with the same set of figures as No. 3. Instead of the differences being used, however, the actual morning and evening values have been plotted.



Allowing for the familiar effect on Monday, which results in a better condition on Monday evening than in the morning, and is followed by the curious deterioration during Monday night, the remaining days of the week show, on Tuesday and Wednesday the effect of two overtime days, on Thursday the lesser effect of an ordinary day, on Friday the exaggerated effect of an overtime day towards the end of the week, and on Saturday the usual lessened effect due to a half-day. This effect of half a day at the end of the week is, however, greater than the effect of a whole day in the middle of the week, on Thursday. The curve also affords an example of the advantage to be gained by avoiding a series of consecutive overtime days. (Page 12.)

Chart No. 6 represents values obtained from a worker in the spinning shed. The test used was the Reaction Time (letters) as in No. 5. . . .

TABLE.
Fatigue=E—M.

Reaction Time	— M.	M. Ill	T. 1.17	W. 1.38	Th. 1.74	F. 1.44	S. 1.70
(Letters)	E.		1.63	2.20	1.88	1.78	1.35
	M—E	—	— .46	— .82	— .14	— .34	.35 (Differences)

The curve in this case is complicated by the illness of the worker. Two processes were at work, one the gradual recovery from illness, the other the gradual development of fatigue. The result of the former process may be recognized in the indications of less fatigue on Thursday than on Tuesday produced by a normal day's work, and similarly by the fatigue of Friday being less than that of Wednesday, both overtime days. Usually the opposite result is obtained, and similar amounts of work produce more fatigue at the end of the week than at the beginning. The recovery on Saturday—a half-day—should be noted.

By arranging the figures somewhat differently the effect of the extra strain of overtime on this subject, rendered unusually sensitive by illness, is brought out even more clearly.

In Chart No. 6A the actual figures obtained are plotted instead of the differences between morning and evening values. An ordinary day's work on Tuesday produces much fatigue. The effect is exaggerated on Wednesday, when overtime was worked. On Friday, recovery from the illness seems to be fairly complete and although near the end of the week, an overtime day produces less effect than on Wednesday, just as the ordinary day's work on Thursday produces less effect than a similar task on Tuesday.

There is evidence of a similar dual effect in those portions of the curve indicating recovery from fatigue, the usual weekly course of which is modified by the passing away of the state of illness.

We have then several sets of results from different individuals obtained by different methods. The results are strikingly similar in their indications. On overtime

days fatigue is indicated in the curves by changes of considerable magnitude, whereas, when normal hours have been worked, such indications are slight. The methods depend upon the acuity of the sense of sight, the acuity of the sense of hearing, the height of the blood-pressure, and the recognition of different letters.

The curves given represent the results of a small proportion of the many hundreds of tests carried out recently. Those selected will serve to indicate the general character of the whole.

CHART No. 6A.

COMPLEX REACTION (LETTERS).

Factory E, Spinner No. 15.

(Week ending November 6th, 1915.)

Actual values plotted.

A fall of the curve indicates the development of fatigue.

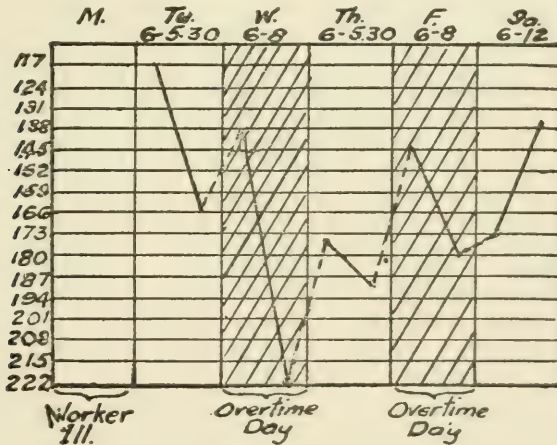


CHART No. 8.

CURVE OF RECOVERY.

COMPLEX REACTION TIME (COLOURS).

Actual values plotted.

Factory E, Winder No. 12.

(Week ending 30th January, 1916.)

A rise of the curve indicates recovery.

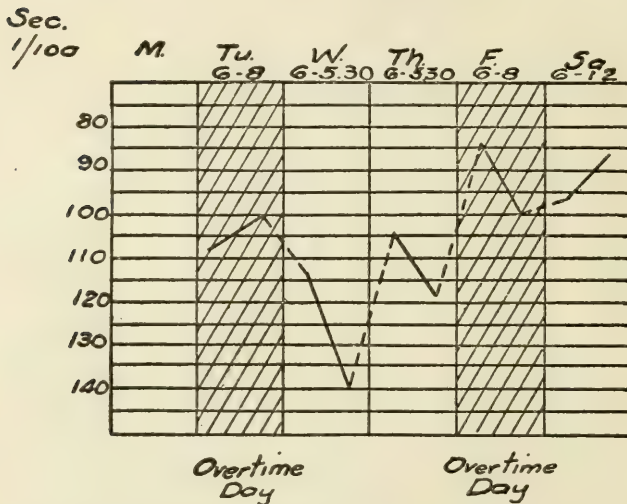


Chart No. 8 illustrates a case in which no work was done on Monday. On Tuesday night a fall resembling the ordinary Monday effect occurred. On Wednesday and Thursday nights good recovery took place after days of ordinary length, whilst on Friday night, after overtime, recovery was much diminished.

The recovery already dwelt with occurs during the interval between the cessation of labour in the evening and its resumption in the morning. (Page 19.)

It is evident that overtime produces in the worker differences of physiological state which affect different functions of the body and which may be recognized by several tests. It is necessary to examine more closely this physiological difference and the conditions under which it appears. (Pages 14-15.)

When once an individual has, through labour during ordinary hours, reached a certain degree of fatigue, and proceeds to further labour (overtime) without taking the repose necessary to dissipate the fatigue already produced, this further labour has a greater physiological effect and exhausts the organism more than would a similar amount of labour performed when fatigue was absent. This is a well-known fact in physiology; it is also a matter of ordinary experience. It is of importance in the present connection because it indicates that OVERTIME LABOUR IS MORE HARMFUL TO THE WORKER THAN LABOUR PERFORMED DURING ORDINARY HOURS. IT IS THEREFORE PHYSIOLOGICALLY EXTRAVAGANT.* (Page 16.)

The Influence of Overtime Upon the General Health of the Worker.

The influence of overtime upon the general health of the worker, apart from his condition with regard to fatigue at any particular moment, is of importance, since speed of working, and the endurance necessary for prolonged labour, must depend upon general health. It is difficult to find a satisfactory means of gauging and of expressing in numerical terms, this general health, or "fitness". The condition is difficult to define, and still more difficult to measure and to register. Moreover, the individuals met with vary so much amongst themselves that a condition which might perhaps be called "fit" in one case, would be quite "unfit" in another.

An attempt has been made to solve the difficulty by collecting and analysing the results of certain tests carried on over a period of some weeks, during which the conditions with regard to overtime and the early morning period were varied. As in former tests it was found undesirable to compare the results given by one individual with those given by another—the variations referred to above destroy, for present purposes, the

*The payment of higher wages renders overtime economically extravagant also. Yet higher wages are not sufficient to make it universally desired by the workers. Enquiries were made of 18 operatives in various departments of a large factory as to whether the overtime day with its extra rate of pay, or the ordinary day, ending at 5:30 p. m. would be preferred. In reply 15 voted against overtime, the remaining three stating that they were indifferent in the matter.

value of any such comparison—but the results obtained at one period have been compared with the results obtained at another period from the same individual, and thus it has been possible to form an estimate of the influence of varying conditions of labour.

The values taken are the averages between the morning and evening figures. The abolition of overtime, leading, as it does, to a shortened day, would naturally be followed by an improvement in the evening condition of the worker, but by averaging the evening value with that obtained in the morning, the effect of the shortened day is diminished, and the condition of the worker in the morning, after a period of rest, is brought in.

The first test used was the Complex Reaction Time, and this was applied to three individuals, No. 35A, 33, and 35, who had been remarked as especially regular in their attendance at the mill. The experiment was carried on for a period of six weeks, the conditions being varied from time to time. During the first fortnight the hours worked were the full ordinary hours of the mill in war time, that is to say, from 6 a. m. to 8 p. m. with two hours off for meals. Thus the day consisted of twelve working hours, and the operatives showed some signs of overstrain. During the second fortnight the overtime period (6 p. m. to 8 p. m.) was suspended, the day commenced at 6 a. m. and ended at 5:30 p. m. and consisted of ten working hours. During the third stage of the experiment the early morning period also was suspended and the day commenced at 8:30 a. m., ended at 5:30 p. m., and consisted of eight working hours. (Pages 60-61.)

TABLE I.

Showing the Influence of Overtime on the General Health of the Worker—Lint Packers.

Complex Reaction Time—Letters.

Averages of Morning and Evening Values for the three Periods—

Period I.—Overtime and Early Morning Periods worked.

Period II.—Overtime suspended.

Period III.—Overtime and Early Morning Periods suspended.

	No. 35A.	No. 33.	No. 35.
Period I.....	1.17	1.05	1.38
Period II.....	0.89	0.87	1.13
Period III.....	0.88	0.86	1.02

(Page 62.)

In all of these cases the suspension of overtime was followed by a diminution of the reaction time, indicating an improvement in the general condition of the worker. In one instance the cessation of the early morning period produced a further improvement.

In order to test the matter further, a similar investigation was carried out in another Department, where the workers were engaged in a different class of work. Tests identical with those already described were carried on for a period of about six weeks, the periods corresponding to those described previously. The workers selected were seven women employed in the winding room. (Page 61.)

TABLE III.

Showing the Influence of Overtime on the General Health of the Worker—Winders.

Complex Reaction Time.—Letters.

Averages of Morning and Evening Values for the three Periods.

Period I.—Overtime and Early Morning Period worked.

Period II.—Overtime suspended.

Period III.—Overtime and Early Morning Periods suspended.

	No. 8.	No. 10.	No. 12.	No. 11.	No. 14.	No. 13.	No. 14A.
Period I.....	1.42	1.04	1.14	1.06	1.22	1.36	1.52
Period II.....	1.13	0.92	0.96	1.01	1.07	1.20	1.25
Period III.....	1.04	0.96	0.94	0.99	1.02	1.19	1.18

(Page 63.)

The general health of the worker, upon which his rate of working and his powers of endurance depend, so far as it can be gauged by the tests used in this investigation, appears to be prejudiced by the introduction of overtime, and, to a less extent, by work in the early morning hours. The suspension of overtime was followed in every case by an improvement in the condition of the worker. In a large proportion of cases that condition was further improved by the suspension of work in the early morning hours.

Where an estimate was made of the time lost by the worker, and this was taken as an indication of his general health, the suspension of overtime was found to result in a saving of time of four and a half per cent. The subsequent suspension of the early morning period was followed by a further diminution in the time lost. (Page 65.)

Report of the British Chief Inspector of Factories and Work-Shops for the Year 1915. May, 1916.

The scope of possible exemption has been materially increased, and in spite of the fact that the need of over-

time in certain industries, and more particularly in the making of clothing and boots, shirts, leather equipment and surgical dressings has for the present at all events ceased, the number of applications for Orders show little sign of diminution. There is, however, a marked reduction in the amount of latitude sought and allowed; for instance, fresh demands for permission to work on Sundays are now rarely received, and are confined to cases where sudden and unexpected emergency arises or the processes are continuous. Requests for Saturday afternoon work have also become less common, and there seems to be a more general recognition of the advantages of a week-end rest. . . .

Many of the schemes put forward were considerably within the maximum allowed, and even where the maximum was sought it has been found in practice that the full number of hours were frequently not worked.

While this Order has satisfied the needs of the greater number, many special Orders have been required, more particularly for the large munition firms, in some of which the hours remained somewhat in advance of those permitted by the General Order. There has, however, been observable a distinct tendency towards a reduction of hours in these works as elsewhere. Sunday labour has been found to be more and more unsatisfactory; apart from the ill-effects which must follow from a long-continued spell of working seven days a week, it too often results in loss of time on other days of the week and in consequent disorganization, and employers were perhaps the more ready therefore to accept the recommendations of the Health of Munition Workers Committee that it should be abandoned. They have been encouraged, too, in this direction by the action of the Ministry, who issued a circular to all controlled factories, urging the importance in the interests both of the workers and production, that a weekly rest period—preferably Sunday—should be secured to all workers. The following is an extract:

The aim should be to work not more than twelve shifts per fortnight or twenty-four where double shifts are worked. . . . Where three eight-hour shifts are worked, not less than two should be omitted

on Sunday. It is, in the opinion of the Minister, preferable to work a moderate amount of overtime during the week, allowing a break on Sunday, rather than work continuously from day to day. It is still more strongly his view that where overtime is worked in the week, Sunday labour is not desirable. (Pages 5-6.)

In July it was found that overtime in weaving had again become essential, owing to the urgent need for Army flannel shirting and hospital serge, and after consultation with the Army Contracts Department, it was decided to allow women and young persons over sixteen years of age employed in weaving these cloths to work overtime up to a maximum limit of two hours overtime on four nights a week, or an equivalent. In November, however, it was felt that there must be a break in this long spell of overtime, and all existing Orders were cancelled and were not renewed till after the end of the year. (Page 7.)

The Health of Munition Workers Committee were able to report as regards munition works that they "had not found that, as yet, the strain of long hours had caused any serious break-down among the workers, though many general statements indicative of fatigue had been received." This is confirmed by the reports of Inspectors from all parts of the country. . . .

There can be little doubt that the high wages, and the better food that the workers have been able to enjoy in consequence, have done much to counteract the strain of long hours and to bring about this result. At the same time it cannot be said that there are no indications of fatigue of a less serious kind. Individual workers confess to feeling tired and to becoming "stale;" there are complaints of bad time-keeping and there is a general tendency towards a reduction of hours. But fatigue of this kind is quickly overcome by a temporary rest from overtime, though the importance of such relief has not always received sufficient recognition. It is essential if full advantage is to be obtained from increased hours, that the effects of overtime on individuals should be carefully watched, and that workers should be temporarily relieved from it when fatigue becomes apparent. . . .

This policy of temporary relief has been pressed by the Home Office in a number of cases where overtime has been continued uninterruptedly for considerable periods. Thus, in certain cotton mills, periodical medical examination of the workers has been made a condition of a continuance of overtime, and power is given to the examining surgeon, by consent, to suspend, either wholly or for a period, anyone showing undue signs of fatigue. This has proved a satisfactory safeguard. Workers thus suspended quickly recuperate, and are able to return to overtime after a short period with renewed vigor. Again, in the woollen trade, the Inspectors found that the long period of overtime was bringing in its train signs of undue fatigue. Steps were therefore taken to stop all overtime for a period, and when a new General Order was issued, a special condition was included that it should not apply to any department of a factory in which overtime had previously been worked, unless the overtime for women and young persons employed in that department had been discontinued for at least four consecutive weeks within the three months preceding. Similarly, in the General Order for hosiery, a condition is included (in this instance at the suggestion of the employers and operatives concerned) that every fourth week must be kept entirely free from overtime. (Page 9.)

B. INCREASE IN LOST TIME.

Examination of the workers shows that during overtime the "time lost" at starting and stopping and throughout the day exceeds by ascertained percentages the "time lost" under shorter hours. The greater expenditure of energy by the worker during periods of overtime is balanced, often unconsciously, by a lessened application to work. Evidence is here presented to show that "time lost" and exhaustion of energy run *pari passu*.

British Home Office. Second Interim Report on an Investigation of Industrial Fatigue by Physiological Methods. A. F. STANLEY KENT, M. A., D. Sc., Henry Overton Wills Professor of Physiology, University of Bristol. London, 1916.

Equilibrium and Balancing.

Every individual commences labour with a definite store of energy. When work is performed, energy is dissipated. When rest is taken, energy is renewed. But recovery takes place and fresh energy is made available, even whilst work is in progress. As a rule, energy expenditure preponderates during work, energy renewal, or recovery, preponderates during rest. (Page 48.)

The available energy is used in the performance of labour at a definite rate for a definite period. Under peace conditions, or where slackness prevails, there may be a considerable balance of energy unexpended at the end of the day, but where the hands are working up to their full strength, most of their energy has been expended by evening. Next morning a new balance is available and carries the worker on for another day, but, since recovery in the course of the night is seldom perfect, an increasing debit balance is carried forward from day to day, to be liquidated at the week-end, provided the week-end rest be taken.

Thus, the worker will not be markedly less efficient

at the end of any particular month than at its beginning; the factors concerned will be in equilibrium.

When the resources of the mill are strained to meet an unusual demand, one of the first steps to be taken is a lengthening of the hours of labour—in other words, the introduction of overtime. Where the rule has been a ten-hours day, an extra two hours' shift may be introduced in the evening.

Such an alteration in a system already in equilibrium must produce a serious and far-reaching disturbance. The mode of living of the operatives must be altered to conform to the new conditions. Time of meals, time of retiring to rest, and mode of spending the evening will be changed, whilst the two hours' extra work will upset the balance between income and expenditure of energy.

Moreover, since the additional labour must be performed at the end of an ordinary day by an individual who is already tired, the resulting fatigue will be disproportionately great. And since a worker is less able to recuperate after overtime than after a spell of ordinary labour, the effect of the extra work will extend beyond the added period, and will make recovery less perfect.

Evidently, if the worker were already doing his utmost before the introduction of overtime, he cannot supply extra energy for the extra labour and still continue to work at his old rate in the other periods of the day. Some re-adjustment must be made.

It has been shown that the only factor concerned in the maintenance of equilibrium which can be varied quickly and often is the degree of application of the worker to his task. This means of adjustment will be adopted, consciously or unconsciously, and the men will work twelve hours a day instead of ten, but the closeness of their application will be less throughout the whole period.

Some idea of how greatly application may vary, and how much time may be lost when it is imperfect may be gained by keeping the worker under constant observation throughout the day. Two workers, tested in this manner, lost an average of 25.5 per cent., 14.5 per cent. and 18.5 per cent. of the total time in the early morning, morning and afternoon respectively. The greatest loss

occurred in the early morning, when conditions were unfavorable to close application, and when output was low. Indeed, where other things are equal, output may be taken as an indication of application.

A similar adaptation occurs whenever heavy manual labour is performed. Such labour is ever deliberate, or interspersed with periods of rest, without which energy would quickly be exhausted.

Thus, in the adjustment of the application of the worker to his task there exists an arrangement which limits accumulation of fatigue.

If the hands are already working as assiduously as possible when overtime is introduced, the change will involve extra strain. Reaction will take place, application will be relaxed, and the fatigue produced per hour will be lessened in consequence. Thus the balance will be restored, but at some sacrifice of efficiency. Fatigue will develop at a slower rate for a greater number of hours per day, and recovery will be less perfect. The general efficiency of the worker will be lessened. (Page 49.)

It is possible to test the influence of overtime in another manner. It has already been shown that factory workers often lose a considerable amount of time in their daily work. It is probably incorrect to call such lost time wasted, since the cessation from labour seems to be brought about as a result of a distinct need of the organism for rest. The time therefore is not wilfully wasted, but is employed as a breathing space, and for recovery from fatigue.

Since the loss depends upon fatigue, or upon a condition produced in the worker as a result of fatigue, it is likely that its amount will be greater when fatigue is increased, and there is evidence to show that time lost and exhaustion of energy run *pari passu*. It is easy to estimate the amount of time lost, and to draw conclusions from this as to the general condition of the worker, and provided the data used are sufficiently extensive, the result will be useful.

An enquiry on these lines was carried out upon a group of eight workers, and extended over a period of about six weeks. The time was divided into three experimental periods, during which the conditions of

labour were varied. In the first period work commenced at 6 a. m. and continued till 8 p. m. with a total of two hours off for meals. In the second period the day still commenced at 6 a. m., but ended at 5:30 p. m. In the third period the day commenced at 8:30 a. m. and ended at 5:30 p. m. During the Period 1, therefore, work should have been carried on for a total of twelve hours in the day. Reference to the figures of Table V on p. 64 shows that on no single day of the period, was the full twelve hours worked. The nearest approach to it was on Tuesday, 25th January, when 11 hours and 23 minutes were worked. On Thursday, 27th January, only 8 hours and 14 minutes were worked. . . .

The time lost during the first period, 2 hours and 6 minutes, is 17.5 per cent. of the total time of the day. During Period 2, the time lost was 1 hour and 18 minutes, and this is 13 per cent. of the daily period of labour. Thus, a diminution in the length of the working day has diminished the loss of time to a disproportionate extent, and, just as it has been shown that a lengthening of the working day leads to an increase of fatigue which is disproportionate to the added hours, so here it is found that a long day leads to much loss of time, which is greatly reduced when the day is shortened.

Unfortunately, it is impossible to draw any useful conclusion from an examination of the figures for Period 3, since, whilst the experiment was in progress, trouble arose in another department of the mill and, as a result, the workers were disturbed and their occupation disorganised. Hence, a great deal of extra time was wasted.

TABLE V.

Average Time Worked per day during Experimental Periods I, II and III for a group of eight workers:

Period I.—Overtime and Early Morning Period Worked.

Period II.—Overtime suspended.

Period III.—Overtime and Early Morning Period suspended.

PERIOD 1.					PERIOD 2.				
					</				

. . . Under wrong conditions of work with excessive overtime, it is to be expected indeed that some deliberate "slacking" of the workers might actually give an improvement of output over a period of some length by sparing wasteful fatigue, just as the "nursing" of a boat-crew over part of a long course may improve their performance. It cannot in such circumstances be said that a workman so restraining himself, consciously or unconsciously, is doing more to damage the output on the whole than the employer who has arranged over-long hours of work on the baseless assumption that long hours mean high output.*

* It is said that women workers now engaged upon munitions have no customary usages of sparing themselves, and that the weekly output per woman often exceeds that per man. The experienced manager of a large shell factory employing 1,200 men and 1,500 women expressed his confidence that the three 8-hour shift system gives better output and maintains better health than of two 12-hour shifts. He is "satisfied that there is a period of slacking, *often quite unconscious*, during a 12-hour shift which is detrimental to output." Investigation elsewhere suggests, however, that the output for the long shift might be even worse without this unconscious restraint. (Pages 7-8.)

C. THE NATURE OF FATIGUE.

The injuries to health from excessive hours are explained by the chemical nature of fatigue. This phenomenon is authoritatively set forth anew by Sir George Newman's Committee.

Other studies assert that extreme exhaustion in warfare may result ultimately in a genuine degenerative lesion.

British Ministry of Munitions. Health of Munition Workers Committee. SIR GEORGE NEWMAN, M. D., Chairman. Memorandum No. 7. Industrial Fatigue and Its Causes. London, 1916.

1.—Fatigue is the sum of the results of activity which show themselves in a diminished capacity for doing work.

In ordinary language fatigue is generally associated with familiar bodily sensations, and these sensations are often taken to be its measure. It is of vital importance for the proper study of industrial fatigue, however, to recognise not only that bodily sensations are a fallacious guide to the true state of fatigue which may be present, and a wholly inadequate measure of it, but also that fatigue in its true meaning advances progressively, and must be measurable at any stage by a diminished capacity for work, before its signs appear plainly, or at all, in sensation.

2.—In the animal body the performance of work depends on the activities of parts which are best considered under three groups—first, the complex nervous mechanisms of the brain and spinal cord, which are concerned in the initiation and distribution of impulses to action; second, the nerves, which conduct the impulses to muscles; and third, the muscles themselves, which by contracting finally perform external work.

Fatigue has been separately studied in all these parts. In its essential features the fatigue of all alike has been found, when it occurs, to depend not upon the simple using up—"exhaustion"—of the substances supplying the chemical energy which is liberated during work, but upon the accumulation within the living elements of the

products of the chemical changes involved. Fatigue of the animal machine, that is to say, is not to be compared with the failure of fuel as in a steam-engine, or with the running-down of a clock-weight, but rather with the clogging of the wheels in some mechanism by dirt. (Page 3.)

3.—The necessary time-relation between an action and the recovery from it in rest has been mentioned already. For every acting element a given rhythm of activity will allow exact recovery after each act, and will maintain the balance between action and repair throughout a long series. The heart, for instance, in alternating contraction and relaxation, may continue to beat incessantly through the life of a man without any accumulated fatigue for seventy years or more. Among the great variety of nerve centres there will be found a great variety in these time-relations. Some may allow a relatively rapid rhythm, as in the act of breathing, where the rhythm, which is a nervous rhythm, may be almost incessant for years, while at the other end of the scale there are slower rhythm like those shown in the need for diurnal sleep. . . .

4.—The problem of scientific industrial management, dealing as it must with the human machine, is fundamentally a problem in industrial fatigue. The rhythms of industrial conditions, given by the hours of labour, the pace of machinery or that of fellow-workers, or otherwise, are imposed upon the acting bodily mechanisms from outside. If these are faster than the natural rhythms, they must give accumulated fatigue, and cause an increasing debit, shown in a diminished capacity for work. (Page 4.)

5.—Fatigue following muscular employment is primarily nervous fatigue, as explained already, and we have seen that no advanced degree of muscular fatigue as such can be obtained by voluntary action, for fatigue in the nervous system outstrips in its onset fatigue in the muscles. . . .

For work in which severe muscular effort is required it seems probable that the maximum output over the day's work and the best conditions for the workers' comfort and maintained health, will be secured by giving short spells of strenuous activity broken by longer spells of rest, the time-ratio of rest to action being here, for

maximal efficiency, greater than that for the employments in which nervous activity is more prominent or more complicated than in the processes involved during familiar muscular work.*

8.—For practical purposes in industrial management two chief characters of nervous fatigue must be observed. First, during the continued performance of work the objective results of nervous fatigue precede in their onset the subjective symptoms of fatigue. Without obvious sign and without his knowing it himself, a man's capacity for work may diminish owing to his unrecognised fatigue. His time beyond a certain point then begins to be uneconomically spent, and it is for scientific management to determine this point, and to determine further the arrangement of periods of rest in relation to spells of work that will give the best development over the day and the year of the worker's capacity. Second, the results of fatigue which advances beyond physiological limits ("over-strain") not only reduce capacity at the moment, but do damage of a more permanent kind which will affect capacity for periods far beyond the next normal period of rest. It will plainly be uneconomical to allow this damage to be done. (Page 6.)

British Association for the Advancement of Science. Newcastle, 1916. The Question of Fatigue from the Economic Standpoint. Second Interim Report of the Committee, PROF. J. H. MUIRHEAD (Chairman), MISS B. L. HUTCHINS (Secretary), MR. P. SARGANT FLORENCE (Organising Secretary). Report drawn up by MR. P. SARGANT FLORENCE.

Accumulated Fatigue in Warfare; Dr. Gwynne
Maitland.

The present war supplies unlimited material for the study of fatigue, but there is little opportunity afforded

* This point is one of incessant practical interest in many industries, and it may be noted that it has an immediate bearing upon the routine proper for rapid trench-digging. Two officers at the front recently, for a friendly wager, competed in making equal lengths of a certain trench, each with an equal squad of men. One let his men work as they pleased, but as hard as possible. The other divided his men into three sets, to work in rotation, each set digging their hardest for five minutes and then resting for ten, till their spell of labour came again. The latter team won easily. The problem here gives another obvious opening for scientific organisation based on the results of experiment.

for experimental examination; one must for the most part be content with clinical observations.

There is one outstanding advantage in these cases as compared with civil cases; it is that they show much greater severity, and so enable one to realise to what extent fatigue may be responsible not only for functional disorders, but ultimately for permanent constitutional lesions.

There is, however, this great disadvantage, that there is no opportunity for submitting these, as one can submit civil cases, to experiment. It is obviously impracticable to be in the position and to select the opportunity for measuring work before and after the strain of field and trench work.

By experience of work in the field and by the observation of cases, useful conclusions can be reached, and some measure of reform has already been forced upon the army.

The soldier has a limited capacity for work, but if he has been carefully trained that capacity may be increased; on the other hand, if his capacity is exceeded, and recuperation is not permitted to him, that capacity may undergo so much diminution as to render him quite unfit for military purposes.

Military necessity, the impossibility of bringing up relays for replacement, the inability to provide sufficient rest and uninterrupted sleep, prevent the army from getting the greatest possible value out of the unit.

It was, indeed, found that long-continued trench strain resulted in cases of breakdown which certainly recovered after a period of rest, but such cases were left with a shorter period of utility on their return to the trenches, and, breaking down again, frequently discharged as of no further use. Not only was the period of activity shortened, but the quality of their work deteriorated, as evinced by their inaccurate shooting, by their inability to time hand-grenade fuses, by hesitation in matters which demanded quick and intelligent decision, and in various other ways. (Page 3.)

Unfortunately, of course, the actual strain involved varies with the occasion, and the matter is further complicated by various other conditions, such as the time and

amount of the place for rest and sleep, the adequacy and sufficiency of food, the amount of noise and sensory disturbances generally, and the nervous strain of exposure to fire, and so on.

It is obvious we must therefore dispense with the hopes of obtaining an ideal working day for each military unit.

All that we can reasonably hope for is that, with the present greater ability to supply reinforcements, we can diminish the strain as well as more frequently replace the actual fighting units; and it becomes a matter of the greatest urgency that with this ability, and with the growing delicacy of perception in the anticipation of the breaking-point, a greater discretion might be employed to prevent it. . . .

The cases which are more important to consider from the point of view of military values is the great class of combatants which do not collapse in the field, but yet betray to some extent the symptoms of these graver cases. They manage to come through without collapse, but they too display extreme pallor, their blood pressure is extremely low, their heart feeble, and they also exhibit an extreme and incessant restlessness of the hands and feet—*faiblesse irritable*. In this condition they are practically useless as a fighting unit, and are in fact a genuine encumbrance. Fatigue here again has gone slightly beyond the possibility of sound physiological recuperation, and the tissues show depreciation by the celerity with which fatigue is induced on the next occasion for great physical strain. It becomes, then, a matter of the greatest urgency to see these soldiers are replaced before this excessive fatigue is established; that, of course, can only be done empirically by a knowledge of the endurance of the soldier in the present type of warfare. It is essential that these soldiers return to the fighting line with their capacity for work undiminished, and it is with this object in view that the hours in the fighting line have lately been limited and the period of rest increased. (Page 5.)

Finally the result we have to expect if the demand for adequate rest and recuperation is not satisfied is that a permanent lesion is established.

From this last type of case we perhaps ought to exclude those cases which after great exposure and great strain betray or develop on the one hand tubercular trouble, on the other those cases which, through inherent heart-weakness, develop dilated hearts and incompetent heart-valves. The cases which are especially instructive are those cases which show no other lesion than the arterial.

It was extraordinary to observe how many Serbian soldiers, who have lived through the Balkan wars culminating in this present war, revealed *arterio sclerosis*. Their temporal vessels were always markedly tortuous, and, on examination, almost all palpable vessels were found to be thickened and tortuous.

There seems no better illustration of the result of hard work on arteries than this continued war strain. Hard work has long been stated to be an alternative to the acute specific toxins in the productions of fibrosis in arteries, but has never received much attention.

It was in almost all the above cases possible to exclude the mineral poisons, alcohol, and specific toxins, and by exclusion the only conclusions which could be arrived at was that accumulative fatigue bodies themselves act as an arterial toxin. Moreover, it is necessary to remember the great demands made upon the vasomotor system, which is constantly in requisition in hard work, and therefore constantly demanding oxygen. With the tax made upon the heart in extreme stress the heart may fail to remove the fatigue bodies, which, accumulating, may irritate the delicate muscular mechanism in the arterial walls. This irritation, with the relative absence of anabolic bodies and oxygen, results in a degeneration of muscular tissue, and the artery in self-defense undergoes fibrous degeneration.

The history of six years of Balkan wars prove beyond dispute that the strain of forced marching, inadequate food, insufficient rest and sleep, resulting in a temporary and functional fatigue to begin with, may ultimately, through a gradual depreciation of tissue, cause a genuine degenerative lesion. (Pages 5-6.)

*Is the Eight-Hour Working Day Rational? Science, N. S., November 24, 1916.**

In the evolution of the eight-hour day England, of all countries, presents the most interesting history. Diligent search has failed to reveal the origin of the traditional division of the diurnal twenty-four hours into eight hours each of work, recreation and sleep. It is said that the customary duration of the working-day of the fifteenth century was eight hours. Whether this be true or not, during the subsequent three hundred years all the evils of unrestricted labor flourished vigorously. At the beginning of the nineteenth century most English artisans were accustomed to work from eleven to fifteen hours in the day. No delicate physiological tests were needed to demonstrate what such a system was doing to destroy the vital mechanisms of men, women and children. The results were sufficiently obvious, and the next one hundred years were marked by a series of struggles between workers and humanitarians on the one side, and capitalists on the other, in which progress toward a physiological working-day was gradually, though slowly, made. After sporadic reductions of the working-period to twelve hours or less, a ten-hour movement was succeeded in time by a nine-hour movement, and by the middle of the century the eight-hour day had been definitely proposed. It was won first, not in the mother-country, but by the artisans of Melbourne, Australia, in 1856, and this date marks the beginning of achievement of the eight-hour movement. In the United States agitation in its favor began immediately after the close of the Civil War, stimulated, no doubt, by the great extension of industrial work which then occurred. Thus, since the middle of the nineteenth century the eight-hour day has been the goal of labor. Such a day presupposes one day's rest in every seven and thus signifies a forty-eight-hour week. It is usually coupled, however, with an extra half holiday, which for the majority of persons would be taken on Saturday afternoon. In this manner the week's work would be reduced to forty-four hours, and this represents the present demand of the eight-hour movement. Partly

* Read before the Section on Industrial Hygiene of the American Public Health Association, Cincinnati, October 25, 1916.

by law and partly by private agreement between employer and employed the eight-hour day has been granted in recent years to one group of workers here and another there, usually localized groups and rarely including all the workers in a single industry of a single country. (Pages 727-728.)

What should determine the duration of daily labor? Here I would place, as of first importance, the physiological effects of the work and, as secondary and subordinate factors, its economic and social features.

The physiological effects of labor are now so well known as to require here only brief mention. The expenditure of energy by the bodily organs involves chemical and physical changes in them which, if continued, leads to the physiological state of fatigue. Fatigue is characterized chemically by the diminution within the acting tissues of chemical substances that have previously been stored within the living cells and either serve as sources of energy or are otherwise essential to tissue activity; and by the appearance within the living cells of other chemical substances, products of katabolic action, which are known as fatigue substances and react upon the tissues to decrease their power of responding to stimuli. If the same amount of work as before is then to be performed by the organs, the nervous system must send to them more powerful impulses, and when this becomes no longer possible the amount of work decreases. Fatigue substances spread from the place of their origin to other organs and react upon them, and thus the activity of one physiological mechanism, such, for example, as a neuromuscular mechanism, fatigues others. In fatigue the senses are less acute; attention is less sharply focused; the power of discrimination is lessened; the muscles are weakened; the quickness and the accuracy of muscular action are decreased; glandular secretions seem to be decreased; the heart-beat may be slowed or, in extreme cases, possibly quickened and irregular; the blood vessels of the skin are dilated and draft an undue quantity of blood away from the brain. In fatigue the sense of weariness obtrudes and oppresses; but it cannot be too strongly emphasized or too often reiterated that the feeling of fatigue is a very uncertain index of

the presence of a measurable degree of the fatigue of the tissues.

All these physiological changes may be within normal limits, and by rest the irritability of the tissues can then be readily restored and the freshness of sensation and the vigor of mind and muscle can be brought back. But if the work has been too strenuous or too long-continued, if the chemical changes in the tissues have gone too far, or if rest has been unduly curtailed, fatigue passes over into a pathological state which is known as exhaustion and is far less easily recovered from. Not only is the power of achievement then further diminished, but susceptibility to specific disease is increased. There may be a general neurasthenia or other diseases of the nervous system, including nervous affections of the bodily organs. The will may be weakened, and resistance to immoral temptations may be lessened. Intemperance is one of the common results of bodily exhaustion, and even crime itself finds here one of its prolific sources. Resistance to infectious disease may be diminished, apparently because of a diminution of the protective antibodies. Thus excessive fatigue may bring in its train many disastrous sequelæ with much physical and moral misery. The seeds of this more serious state are often sowed in industrial work, when the conditions of labor and living are such that a residuum of the fatigue of one day is carried over to the next and from day to day there is a cumulative, even if slight, diminution of physiological powers.

Let us develop a little further this topic of the physiological effects of labor. Laboratory experiments have demonstrated that the degree of fatigue of a muscle in a given time varies in accordance with both the amount of the weight lifted and the rapidity with which stimuli are sent to the tissue. Increasing the weight, or making the muscle contract more rapidly, increases the degree of fatigue in a given time and, if continued, brings on earlier exhaustion. These facts have their counterpart in industrial work, for fatigue here too depends on the intensity and the rapidity of repetition of the individual acts performed by the laborer. In general it may be said that the introduction of so-called labor-saving machinery has diminished the intensity and increased the

rapidity of repetition of the laborer's acts. Lifeless machines now often lift the heavy weights once raised by human muscles. Other lifeless machines, intricate and automatic, relieve the laborer of much of his former light muscular work. But these same machines need to be tended by human agencies and set the pace for human activities, and the tendency is ever toward increasing the quickness and the constancy with which sense-organs, brain, spinal cord and muscles must act. (Pages 728-730.)

Let me here summarize. Of the various agencies that have been considered as legitimate factors in determining the length of the working-day that which appears to me the most weighty is the physiological one, the physiological effects of the labor on the individual laborer. In the pursuit of his vocation as the employee of another every human being has a right to the preservation of his physiological powers, to the avoidance of excessive fatigue, to the continuance of his health. All questions of the percentage of financial profit, all questions of social demands or social opportunity, are subordinate to this. Moreover, this is essential to the other considerations mentioned, for only by the preservation of his health can the economic demands of his work be satisfied, only by this can he acquire and maintain skill and be worthy of responsibility. The whole question of the length of the working-day thus rests primarily on a physiological basis. (Page 733.)

D. THE BAD EFFECT OF LONG HOURS ON OUTPUT.

Striking new proof is given of the decline of output with the imposition of overtime, and the rise in output with a change to shorter hours of labor.

A typical set of observations during four weeks shows for instance that the output of three winders working ten hours a day was found to be greater than their total output when working twelve hours a day by five per cent. The output of one winder working eight hours per day was found to be greater by 8 per cent. than the average output of three winders working 12 hours a day during the first 2 weeks of the experiment and 10 hours a day during the second two weeks of the experiment.

British Ministry of Munitions. Health of Munition Workers Committee. SIR GEORGE NEWMAN, M. D., Chairman. Memorandum No. 7. Industrial Fatigue and Its Causes. London, 1916.

Tests of Industrial Fatigue.

9. The true sign of fatigue is diminished capacity and it follows from what has been said that measurement of output in work will give the most direct test of fatigue.

The output must be measured under the ordinary conditions of the work, and, in cases where from the nature of the work the output is not automatically measured, it must be tested by methods which do not allow the workers to be conscious at particular times of the test being made. In this way the errors due to special effort from interest or emulation will be eliminated. The results of work expressed in output must be corrected by allowance for all variable factors save that of the workers changing capacity; changes in supply of steam or electric power and of raw material, for instance, must be determined for the correction and interpretation of the actual output returns. The output must be estimated for successive short periods (e. g., each hour) of the day's work,

so that the phenomena of "beginning-spurt" and "end-spurt," and other variations complicating the course of fatigue as such, may be traced and taken into account. Isolated tests of output taken sporadically will be meaningless. The records must also extend over longer periods to show the onset of fatigue over the whole day and over the whole week, and under particular seasonal or other conditions, in order to direct and measure the results of accumulating fatigue.

10. Measurements of output must obviously be recorded at so much for each individual or for each unit group. The size of total output will be meaningless of course without reference to the numbers engaged. But it will also be important for proper management to take account of the output of particular individuals. (Pages 6 and 7.)

If the proper adaptation to particular kinds of labour of the relations of spells or shifts of work to rest intervals and to holidays is to be determined, as it can alone be, by appeal to experiment, it will of course be an essential condition for success that the workers should co-operate with the employing management and give their highest voluntary efforts towards the maximum output during the spells of work. It is not surprising that where employers, following tradition rather than experiment have disobeyed physiological law in the supposed interests of gain—and for a century this has been almost universal—the workers have themselves fallen very commonly into a tradition of working below their best during their spells of labour. (Page 9.)

The Committee believe that in the present time of crisis patriotic incentive has done much to abolish customary reduction of effort among munition workers, but it is of great importance to note that a special and strenuous voluntary effort in labour, if it be maintained under a badly arranged time-table of work and rest, does not necessarily bring increased output over a long period, however praiseworthy the intention of effort may be. Under wrong conditions of work with excessive overtime, it is to be expected indeed that some deliberate "slacking" of the workers might actually give an improvement of output over a period of some length. . . .

In a specific instance before the Committee, a group

of five male voluntary Sunday workers in a certain munitions factory were able in 8 hours (or 7 hours free of meals) to exceed the average day's output of eight week-day men, who work 14 hours (or 12½ hours free of meals). These five men worked, no doubt, at a "sprint" which could not perhaps have been maintained daily. But there can be little doubt that they could repeat their 8 hours' effort on, say, four days in a week; and, if so, the startling result follows that they could do in those four days rather more than the whole week's work of an equal set of men adopting the other system of hours. With this, moreover, they could enjoy not only longer nights and more recreation time in each working day, but could also have three whole holidays in the week. Would these five volunteers be "slackers" if they did a full week's work judged by the 14-hour standard, or more, but had three holidays a week (available perhaps for a change of work) and slept longer at night? It is impossible to resist the conclusion that the paid week-day workers at this factory, who have been working their long hours for many months, might have greatly improved both their output and their comfort under a better chosen system of special efforts alternating with suitable rests. The work in question was work of a uniform "repetitive" kind, involving moderate physical exertion. (Pages 7 and 8.)

British Ministry of Munitions.... Health of Munition Workers Committee. SIR GEORGE NEWMAN, M. D., Chairman. Memorandum No. 12. Statistical Information Concerning Output in Relation to Hours of Work. Collected by H. M. VERNON, M. D. London, 1916.

Men Engaged in Heavy Labour.

15.—The labour assigned to male munition workers is, as a rule, considerably heavier than that assigned to women, but making due allowance for the greater strength and endurance of the man, we find that his output is similarly affected by a reduction in the hours of labour. One of the most fatiguing types of munition work so far investigated by me is that of "sizing". In the sizing of fuze bodies the article is usually subjected to four separate

operations, in each of which it is clamped to a small fly-wheel and handle, and is screwed through a steel tap so as to cut a screw thread on it. The operations require no manual dexterity, but they are a great and continuous strain on the muscles of one arm and shoulder, and to a less extent on those of the back. The operatives seldom use both arms, as they prefer to keep the "screwing" hand dry, and use the other one for picking up the oil-covered fuze bodies. The output of a group of 27 operatives was investigated, and the mean results are given in Table V. The hours of labour were always shorter than those worked by the women. They never exceeded

TABLE V.
27 Men Sizing Fuze Bodies.

Statistical Period	Average hours of actual work	Average (relative) hourly output	Hours plus output
6 weeks preceding Christmas (November 8—December 19)	61.5	100	6,150
2 weeks at Christmas (December 20—January 2)	38.3	89
6 weeks after Christmas (January 3—February 13)	51.1	109	5,570
8 weeks later (February 21—April 16)	55.4	122	6,759
2 weeks at Easter (April 17—April 30)	41.0	112
3 weeks later (May 1—May 21)	56.2	124	6,969

71 hours in any one week, and seldom included Sunday labour. The hourly output showed a marked drop during the Christmas fortnight, and a considerable rise (to 118) for the first week after this fortnight, but the average output during the six weeks after Christmas was only 9 per cent. greater than that of the pre-Christmas period, in spite of the fact that the weekly hours of labour were 10.4 shorter. Evidently the operatives took a long time to adapt their rate of production to the shorter hours, for the hourly output subsequently averaged 22 per cent. in excess of that of the pre-Christmas period. This caused the total output to be no less than 10 per cent. greater, and it is probable that even this figure does not represent the full effect of reducing the hours of labour,

for after Easter the hourly output improved a further 2 per cent., and the total output was increased to 13 per cent. above that of the pre-Christmas period. However, a part of this improvement may have been only the temporary effect of the holiday. The week February 14-20 is omitted, as the operatives worked only 41 hours owing to shortage of material. (Page 7.)

British Home Office. Second Interim Report on an Investigation of Industrial Fatigue by Physiological Methods. A. F. STANLEY KENT, M. A., D. Sc., Henry Overton Wills Professor of Physiology, University of Bristol. London, 1916.

The Influence of Fatigue and of Overtime Upon Output.

Experiments were made upon three categories of workers:

Winders.

Surgical Lint Packers.

Boracic Lint Packers. . . .

The duty of the winder is

To replace bobbins as they become empty.

To replace reels as they become full.

To tie up broken yarn.

To exercise general supervision over her part of the machine. This generally consists of 31 bobbins, with the corresponding reels.

The moving and emptying of the "doffings" involves a considerable amount of labour, whilst the constant reaching over and removing of the full reels is by no means light work. Dexterity is demanded above all in tying up the ends of the yarn when a new bobbin or a new reel is commenced and when the thread is broken by accident. The rapidity with which the bobbins are changed also depends largely upon the dexterity of the worker. The work is paid for at piece rates, and there are large differences in the earnings of different winders. (Page 23.)

Determination of Output.

Winders.

Bobbins Per Hour.

The averages come out as follows (week ending 27th November, 1915):

In the first Curve (Monday):

6 a. m.-8 a. m.....	166
8.30 a. m.-12.30 p. m.....	228
1.30 p. m.-5.30 p. m.....	225
6 p. m.-8 p. m. (Overtime).....	167

In the second Curve (Tuesday) the average gives:

6 a. m.-8 a. m.....	172
8.30 a. m.-12.30 p. m.....	198
1.30 p. m.-5.30 p. m.....	242
6-8 p. m. (Overtime).....	162

In the third Curve (Thursday) the averages are:

6 a. m.-8 a. m.....	168
8.30 a. m.-12.30 p. m.....	245
1.30 p. m.-5.30 p. m.....	224
6-8 p. m. (Overtime).....	172

In the fourth Curve (Friday) the averages are:

6 a. m.-8 a. m.....	240
8.30 a. m.-12.30 p. m.....	278
1.30 p. m.-5.30 p. m.....	245
6-8 p. m. (Overtime).....	231

In the fifth Curve (Saturday) the averages are:

6 a. m.-8 a. m.....	244
8.30 a. m.-12.30 p. m.....	303

(Pages 27-28.)

The averages give the following results (week ending 4th Dec., 1915):

Day	Time	Average of all workers	Average of 3 only (Nos. 9, 10, 12), who were present for the whole week
Monday—			
Nov. 29th.....	6-8 a. m.	187	179
	8.30-12.30	241	248
	1.30-5.30	234	254
	6-8 Overtime	214	205
Tuesday—			
Nov. 30th.....	6-8 a. m.	187	203
	8.30-12.30	246	248
	1.30-5.30	239	234
	6-8 Overtime	221	217
Wednesday—			
Dec. 1st.....	6-8 a. m.	228	240
	8.30-12.30	236	225
	1.30-5.30	243	220
	6-8 Overtime	207	216
Thursday—			
Dec. 2nd.....	6-8 a. m.	245	256
	8.30-12.30	260	232
	1.30-5.30	251	235
	6-8 Overtime	236	227
Friday—			
Dec. 3rd.....	6-8 a. m.	230	200
	8.30-12.30	235	230
	1.30-5.30	239	244
	6-8 Overtime	195	196
Saturday—			
Dec. 4th.....	6-8 a. m.	219	253
	8.30-11.15	229	258
	1-4.50	218	207

The curves of both weeks show indications of a similar alteration from day to day of the values for the early morning and overtime output. This alteration, indefinite in the first week and well marked in the second, shows that, whilst at the beginning of the week output was lowest during the early morning period, as the week progressed output during the early morning period improved, whilst, especially towards the end of the week, it

declined during overtime. On Thursday, Friday, Saturday the lowest output is found during overtime.

Two processes appear to be at work, one, the improvement of output during early morning period as "Monday's effect" wears off, and the other, the decline of output during the overtime period as the week's fatigue becomes operative. (Pages 29-30.)

Conclusions formed as a result of an examination of workers in the winding room are confirmed when those in other departments are tested. In the case of women engaged in weighing and packing surgical lint, the values are expressed in pounds wound per hour. The hours of labour are similar to those in the winding room. (Page 31.)

Lint Packers.

The lint packers work four periods in the day, viz:

6 a. m.-8 a. m.
8:30 a. m.-12:30 p. m.
1:30 p. m.-5:30 p. m.
6 p. m.-8 p. m., overtime.

On Saturdays they work overtime from 1 p. m. till 5 p. m.; actual rolling of lint is finished at 4:30 p. m., after which the benches are cleared.

The lint packers are paid a daily wage. (Page 32.)

Summarising these results, the following figures are obtained:

In the week ending December 11th the average output in lbs. per hour for the first three periods of the day was:

Average of First Three Periods.

Tuesday	79
Wednesday	78.6
Thursday	78.5
Friday	76.3

The output for the overtime period for the same days was:

Overtime.

Tuesday	64
Wednesday	59
Thursday	64
Friday	59.5 . . .

Comparing the output during the best period of the day with the output during overtime, the figures are:

Week ending December 11th.

	Best period.	Overtime.
Tuesday	86.5	64
Wednesday	85	59
Thursday	80.5	64
Friday	79.5	59.5

(Page 33.)

Turning to a consideration of output during overtime, it has been stated that those who remain at the mill for overtime are provided with tea, cakes, scones, &c., free of cost, and that they have a period of rest between 5:30 and 6 o'clock. It might therefore be expected that, being fed and refreshed, they would commence the period of overtime with renewed energy and work quickly and well. But the output during this period is the least satisfactory of the whole day.

The reason is perhaps simpler than in the case of the early morning period, and may be attributed principally to one cause, viz., fatigue.

In the first section of this Report, when dealing with fatigue production, the results of fatigue were shown to be conspicuous on days on which overtime is worked. In the class of work we are considering overtime is worked almost every evening. As a result, fatigue is accumulated and makes its presence felt, especially towards the end of the day. . . .

Thus, the unsatisfactory character of output during both the early morning and overtime periods alike is to be attributed to the evil effects of excessive fatigue following upon the working of hours unduly long. (Page 35.)

Data of Output.

Boracic Lint Packers—December, 1915.

In order that the above conclusions might be further tested, the following experiments were arranged:

A.—To determine the effect of an alteration in the

length of the working day upon output in the case of individual workers. (Page 36.)

The majority of the workers adhered to the ordinary times and worked twelve hours a day. One of them, however, No. 14A, very frequently did not attend during overtime. She also habitually commenced work at 8:30 a. m. instead of at 6 a. m. Thus, she usually worked only eight hours a day instead of twelve, and when asked the reason, replied that the extra rest enabled her to work so much more quickly during the day that she was able easily to make up for the lost time.

It should be recollected that "winding" is paid for at piece rates.

Here was a case where an individual worker had decided for herself that it was more profitable to work a short day than a long one. Not only was overtime cut off, but the early-morning period also.

In order to ascertain the result of this shortening of the working day, a determination was first of all made of the output of this particular winder, and of the output of three first class workers in the same room who habitually worked for the full twelve-hours day. To make the comparison more strict, the output on those exceptional occasions when No. 14A worked in the early morning, or during overtime, has been excluded from the tables. Thus the comparison is between a single individual working for eight hours per day and three individuals working twelve hours a day for the first part of the experiment, and ten hours a day for the second part, after overtime had been abolished.

The observations were carried on for twenty-five working days, and on fifteen days of this period No. 14A—the short-time worker—turned out a greater output than any one of the other three workers selected for comparison. On five days she showed a better output than two of the others, on one day a better output than one, and on only three days of the twenty-five was her output lower than any of the others. This result was achieved in spite of the fact that she was absent for the whole of one day and for three four-hour periods in addition, thus making a total absence of two days and a half. On every one of the three days on which she was bottom of the list she was absent for at least a half of

her working day, *i. e.*, for four hours. On one of these occasions she was absent the whole day, so that no output was shown. On the other hand, some of the other workers, though, as a rule, exceedingly regular in their attendances, did occasionally absent themselves, almost always during the overtime period.

Taking the weekly totals, the following results were obtained. In the weeks ending January 29th, February 5th, and February 19th—that is, three weeks out of four—No. 14A showed a better output than any of the other workers. In the week ending February 12th she was bottom of the list. She was, however, absent from work for the whole of the Wednesday of this week, as well as for the afternoon periods of Monday and Tuesday. This represents an absence of two whole days during the week, so that the low output is not surprising.

If the weekly totals of each worker be added together, it will be seen that for the whole period the total of No. 14A was 52,429. The average of the other three was 48,529. Thus, working for eight hours a day against others working twelve or ten, No. 14A showed an output for the whole period better than the average of the others by about 7.5 per cent.

The claim of this worker, that the extra rest obtained by habitually working eight hours a day instead of twelve enabled her to work more quickly and thus to make up the lost time, appears to be justified.

Further, convincing proof that the abolition of overtime may actually increase output of individual workers is afforded by the same set of figures. These figures (pages 47, 48, 49) show that the three full-time workers, Nos. 10, 13 and 8, worked twelve hours per day for the first two weeks of the experiment, whilst overtime was in force, and ten hours per day of the second two weeks, after overtime had been abolished.

The weekly totals of these two periods show that two individuals out of three produced a greater total weekly output in the period after overtime had been abolished than before. The third individual showed a slightly lower output after overtime had been abolished, but she was absent for a total of ten hours in the period.

If the weekly totals be collected, the grand total for the two weeks when overtime was worked is (when cor-

rected for lost time) 67,743. The grand total for the two weeks after overtime had been abolished (similarly corrected) is 71,182.

The difference is rather more than 5 per cent. in favor of the latter period.

Thus, a diminution of 16.6 per cent. in the length of the working day resulted in an absolute increase in the output of over 5 per cent. (Pages 37-38.)

Summary of the above Tables.

1.—The output of No. 14A, working eight hours per day, is greater than the average total output of Nos. 10, 13 and 8, working twelve hours per day for the first two weeks and ten hours per day for the second two weeks of the experiment, by more than 8 per cent.

2.—The total output of Nos. 10, 13 and 8, working ten hours per day, is greater than their total output when working twelve hours per day, by more than 5 per cent.

3.—The average rate of working of No. 14A is 327.7 bobbins per hour, calculated on "works time," against the average rate of 205.0 bobbins per hour of the remaining three. If the number of hours actually worked be taken, instead of "works times," the figures are 143.3 hours for No. 14A, and 206.3 hours (average) for the other three. The rates calculated from these latter figures are 365.9 bobbins per hour for No. 14A, and 235.2 bobbins per hour for the remainder.

Further results of a similar character are shown in the Tables on page 51.

The average rate of working has been determined for the different periods of the day in a group of eight Winders. The experiment lasted six weeks. For the first two weeks the working day consisted of twelve hours, divided into four periods, the early morning and overtime periods of two hours each, and the two middle day periods of four hours each.

For the second two weeks the first three periods of the day were worked as before, but the overtime period was cancelled.

For the third two weeks both overtime and early morning periods were cancelled and the working day came to consist of eight hours only, worked in the two middle periods of four hours each. (Pages 40-41.)

Summary of the Above Table.

	Bobbins per Hour.
Average Rate of Working for the the Morning Period, 8:30-12:30, during two weeks when Early Morning Period and Overtime were worked	262.5
Average Rate for two weeks when Overtime was abolished	276.0
Average Rate for week when Early Morning Period was abolished	316.0
Average Rate for week when Early Morning Period was re-introduced	257.0
Average Rate for the Afternoon Period, 1:30- 5:30, during two weeks when Early Morning Period and Overtime were worked	266.0
Average Rate for two weeks when Overtime was abolished	261.5
Average Rate for week when Early Morning Period was abolished	279.0
Average Rate for week when Early Morning Period was re-introduced	245.0
Average Rate for Two Middle-day Periods, 8:30- 12:30 and 1:30-5:30, during two weeks when Early Morning Period and Overtime were worked	264.0
Average Rate for two weeks when Overtime was abolished	269.0
Average Rate for week when Early Morning Period was abolished	297.5
Average Rate for week when Early Morning Period was re-introduced	251.0

(Pages 42-43.)

Is the Eight-Hour Working Day Rational? FREDERIC
S. LEE, *Professor of Physiology, Columbia Univer-*
*sity. Science, N. S., November 24, 1916.**

The economic argument, that industry can thrive only
with a long working-day and that any curtailment of it
would be destructive, is perennial and has often been

* Read before the Section on Industrial Hygiene of the American
Public Health Association, Cincinnati, Oct. 25, 1916.

potent in discussion. This argument can be met very effectively by pointing to the effects of shortening the working-period on the quantity and quality of output in manufacture. These effects are so uniform that it may be stated as a general law that upon reduction of the daily hours of labor the average quantity of the output of the individual worker undergoes a preliminary decrease, then a return to the original amount, and finally a permanent increase. This augmentation of output occurs, not only with a reduction to ten, but even to eight, hours. Instances of this are numerous. (Page 731.)

Thus, the statistics reveal the utter fallacy of the notion that a longer working-day means a larger output. But the greater product of the short day, is, I submit, at first thought a very surprising fact, and its cause should be inquired into. It undoubtedly rests on a physiological basis, but without more accurate data any explanation of it must be only tentative. If man were a mere non-living automatic machine it would not occur. But his is a very different mechanism, in which that portion which does work, the effector machinery, is directed by a nervous system, which acts now consciously, now unconsciously, and through its receptor machinery is being continually influenced by external stimuli. All employers testify to the increased good-will, better spirit, and improved morale of the workers, that result from the shorter day. Because of these things the workers arrive more promptly at their places and tend to shirk less as the day proceeds. It is not inconceivable that in many cases there is a residuum of fatigue accumulated from the previous longer working-period, which must first be gotten rid of, and that thereafter the effector mechanism is less clogged. It is not improbable that realization of the brevity of the day and the early relief from toil act as a tonic. Such tonics exist: The spurt that occurs during the last hour of labor, irrespective of its length, is a commonly alleged, if not an attested, fact, and is ascribed to anticipation of release. Careful observation has shown too that other psychic influences increase markedly the output of a man's energy. All these varied influences acting upon the nervous system doubtless contribute to increase the expenditure of productive energy in the shorter time. Their combined influence is largely unconscious, and it is

reported that the greater output is often a surprise to the workers themselves. That it has an origin largely in the action on the nervous system of such external stimuli as have been mentioned, is supported by the further facts that with the eight-hour day the workman makes fewer mistakes and spoils less material, and, in general, the quality of his work shows a distinct improvement. Thus, in the light of the facts of experience, the alleged economic necessity of the longer working-period because of the necessity of a greater output falls to the ground. The long working-period defeats its own object.

But the question may still be raised whether the greater output of the eight-hour day does not produce correspondingly greater fatigue and thus in turn defeat its object. I do not think so. If the day's fatigue were a result merely of the amount of energy transformed in producing the product, if here again man were a mere automatic machine, then surely there would be a direct ratio—the greater the product, the greater the fatigue, and nothing would be gained. But the case is not so simple as this. The day's fatigue is a sequel not simply of the amount of energy directly transformed in producing the material output. It is derived also from other sources—from the continuance of one bodily position, perhaps a strained position, from the noise and gross vibration of machinery, from strained attention, from all those minor factors which Abbe has grouped together as sources of his well-named "passive fatigue". A shorter day eliminates these by so much and at its end leaves the worker so much better off than his longer-laboring fellow." (Pages 732-733.)

E. SOME BRITISH COMMENTS.

The Spectator, London. April 22, 1916. Fatigue and Efficiency.

One of the very best things done by the Ministry of Munitions has been the appointment of a Committee to examine the conditions affecting the health of munition workers . . . These Reports taken as a whole constitute one of the most remarkable contributions yet made in this country towards the more humane and more scientific organization of industry. The broad proposition underlying all of them is that by taking better precautions for preserving the health of the worker better industrial results can be achieved, and, it may be added, a greater volume of human happiness secured. . . .

. . . The practice of starting work at 6 or 7 o'clock in the morning, which is common throughout the kingdom, almost inevitably means that the worker starts on an empty stomach. Experience has proved that the work done before breakfast is generally inferior, yet owing to the conservatism both of employers and employed the practice still continues. Everything, indeed, points to the necessity for a drastic reorganization of the hours of working throughout our industries. In order to get the maximum output from the human being short hours are essential.

Unrest and the Rest Cure. How the Government Can Steady the Workers. CANON H. BICKERSTETH OTTLEY (Hon. Secretary, Imperial Sunday Alliance). *The Westminster Gazette. February 11, 1916.*

And it has been the war that has done what years of peaceful persuasion just failed to bring about. It has done it by speeding up the speeding-up system, with the consequent discovery that the watch was almost overwound. Many months ago communications were addressed by the Imperial Sunday Alliance and by the Committee of the Trade Union Federation, and others, to the War Office and to the Admiralty, pointing out the growing evil, and indicating the evident remedy, which has now been recommended and in part adopted. The facts

were considerable and of great volume and variety. For example, at one branch of a sickness society there were found 400 members all making munitions and all receiving sickness benefit; in a Government dockyard there were at the week-end 3,000 men on the sick-list, as against 900 at any previous time. Everywhere one got the same story. First the workers would agree to scrap the rules limiting their hours of labour. Then men who once put in fifty-odd hours a week now did between seventy and eighty. Health would suffer, the men would grow irritable (their irritation in certain cases leading to a craving for stimulants), and thoughtless people would denounce what they took for lack of patriotism.

It was nothing of the sort. It was sheer weariness of mind and body. And the more intelligent amongst the employers saw what was wrong and applied the clear remedy. They reduced the number of working hours, and the amount of work done grew greater. Whereupon they came to the conclusion that, compared with a six-day week, seven days yielded a smaller output and greater discontent.

That growing restlessness, and the apparent paradox that if men were only allowed to work less they would work more, led to the committee of inquiry into munition workers' health.

The London Times, Engineering Supplement. June 30, 1916.

Reserves of Output. (From an Engineering Correspondent.)

The persistent maintenance of overtime, however, gives ground for suspecting that it has not been found practicable to determine the period for which workers can maintain their top speed without a rest. The balance of previous evidence makes it unlikely that the best output can be obtained from a plant or even from a staff of workers on overtime such as is now understood to be usual, worked for a period in any way approaching that for which it has been in force. In some cases men may have mitigated for their individual selves the disadvantage of excessive hours by losing ordinary time to an extent equal to or even greater than the hours they work

overtime. This course would relieve the individual of undue fatigue and enable him to maintain his top speed while at work, if he wished to do so; but apart from the financial aspect, the consequent derangement of the work of the rest of the shop would have a substantial effect on the aggregate production. A considerable source of increased output seems, therefore, to be available when it is required, either by reducing overtime, if longer hours are being worked than is consistent with the best output from the available plant and staff, or by enforcing ordinary time in any shops in which it is being lost to a notable extent.

The Illustrated London News. November 25, 1916. The Hours of War Work.

The Minister of Munitions tells us that, to reach the output on which he has set his mind, he will require at least 350,000 more men and 100,000 more women. . . .

What remains, however, from the State point of view is the problem of how to get out of this vast body of (for the most part) amateur workers the maximum amount of efficiency in the discharge of their work. This is not a counsel of perfection, but is the very essence of the business, and of the most vital importance for everybody at the present juncture. . . .

Now this speeding-up is much more than most of us would suppose a matter of arrangement of the hours of work. Given the maximum of good-will—which we may fairly assume in the present case—it is plain that in all labour in concert the quickest must conform to the pace of the slowest, and that it is this last which really sets the time. A good manager or supervisor will, of course, speedily discover those workers who from no fault of their own, but from what is called the personal equation, are below normal in this respect, and will set them to work by themselves. After this weeding-out, he will be left with a fairly level team of equal speed, and the question before him will then be how much he can get out of them in a given time. This is not so simple as it looks; for, as Professor Stirling has just told us in his Chadwick Lecture, fatigue is not at first consciously experienced by the willing, but is, on the contrary, only evident in the dropping-off of the speed of his work; and

this is borne out by Professor A. F. S. Kent's report to the Chief Inspector of Factories on the association between fatigue and output. It follows, therefore, that, in order to get the maximum result of his or her effort, every worker should leave off work before he or she begins to be tired; and this means short shifts. . . .

Another point is that a "spell off" of at least one day a week is necessary in the interest of the work. Sir Arthur Whitelegge, in his report as Chief Inspector of Factories for 1915, shows conclusively that for either men or women to work for seven days a week in the long run reduces, instead of increasing, his or her output over that of those who only work six. The whole result, therefore, seems to be that, while we all want the maximum amount of work at this crisis to be done at the greatest speed possible, we can only get this by working in as short shifts or relays as may be found expedient with regard to sex and skill. But this all points to a shorter day than even the eight hours which our workmen in time of peace set before themselves as the ideal condition, and which may, perhaps, be dealt with later. F. L.

Engineering. London, August 25, 1916. British Industries.

Indeed, long hours of labour and efficiency are seldom associated, a fact which is at length beginning to be recognized by those set in authority over us. A naval or military officer accustomed to a 7 day week, with work in progress the whole time, has perhaps a difficulty in realizing that the conditions on ship-board and in a factory are in no way comparable, and that the fact that a 24-hour day is unavoidable in the one case affords accordingly no sufficient reason for believing the same system can be adopted without sacrifice of efficiency in ordinary factories. . . .

Instances can be quoted in which work has been taking six times as long as should be the case under proper conditions. On the other hand, those responsible for the speeding-up of our factories should remember that the new methods may involve some increase in the nervous strain on the workman. If, for example, a skilled man is doing a labourer's work in lifting material on to his machine or bench, the strain on his attention which the

skilled operation demands is momentarily relaxed. If, on the other hand, every portion of the work which requires little thought or care is done for him, this relaxation is missing. One large firm in this country, who have very well-organized works, recognize this by allowing the men a quarter of an hour for a smoke in the middle of every morning's work. In other cases where the physical strain is great it is also very important that the workman shall have periodical rest. An athlete or an oarsman can incapacitate himself for the rest of the day by a few minutes of strenuous exertion, and in the wonderful reorganization of the common labour employed at the Bethlehem Steel Works effected by Mr. Taylor it was found necessary to prevent the men working themselves to a standstill in the course of an hour or two, by insisting on them taking frequent short periods of rest.

As bearing on this point, great interest attaches to the report recently issued by the Ministry of Munitions on "Industrial Fatigue and its Causes." The investigations here recorded give, indeed reason for believing that the bad time-keeping for which the black squad of our ship-yards is somewhat notorious may not be wholly without a physiological excuse. American experience has, indeed, proved conclusively that men, if left to themselves are quite likely to attempt to work during the earlier hours of the day at too great a rate, with the result that on the whole the day's output is reduced. A most striking example which confirms this conclusion is quoted in the report above-cited. In one munitions factory, for example, the management made a regulation that the men working on piece in the foundry were to take 15 minutes' rest every hour. This was resented by the men as they thought the output would be lessened and their weekly takings fall. A foreman was therefore appointed to make sure the rule was obeyed. The result was an actual increase in the hourly output.

The Shorter Working Day. PAGE ARNOTT. *The Women's Industrial News*, October, 1916.

The arguments for the Shorter Working Day may be grouped as follows:

Long hours leave the worker exhausted.

(a) Exhaustion is becoming more and more the object of medical execration as the main cause of organic disease. The ordinary infectious functional diseases may be compared to the ordinary accidents to a locomotive on a railway line. But the wearing out and deterioration of the boiler tubes and other essential parts of a locomotive through continuous strain is precisely parallel with the gradual deterioration of the heart and other organs through continuous exhaustion.

(b) Exhaustion, under the most favourable circumstances, renders a man liable to the risk of infection. Vivisectionists inject the anthrax bacillus into white rats, and then show that if these rats are fatigued on a treadmill they die; whereas if they are allowed to rest they live. Industrial poison injections fatigue the worker, lower his vitality and make him an easy prey to infectious disease.

(c) Exhaustion occurs usually in the least favourable circumstances. The conditions are not those of a Sanatorium or such as obtain in the pure air of the Alps, but are those of a normal British factory or workshop, where the temperature, humidity, lighting, heating, and ventilation are sorry affairs, even in the best of trades. When the occupation in question is mining or furnace-stoking, or ships-plate rivetting, or any of the various "dangerous trades," the case is so much the worse. The evils consequent upon long hours are consummated in the abnormally high and abnormally early death-rate of the working-class. . . . (Pages 56-57.)

When the question of Shorter Hours comes up after the war, it may be urged that the production of munitions showed it was possible to work people not merely 80, but as much as 100 hours a week. Even in spite of Sir George Newman's Reports, there will be perhaps a considerable body of opinion which will think that the principle of Shorter Hours has been disproved by the events of the war. It is best to be quite clear about this. There is no doubt whatever that the nation will pay in the long run for the strain of the last two years. Men are not run to a sensational death like a hunted hare or stag, but the slow effect of perpetual strain is shown in organic disease, nervous disease and general physical debility. It will take another generation before we are free from the effects of these two years. (Page 60.)

II. GROWTH OF INDUSTRY IN THE STATE OF OREGON DURING THE DECADE 1899-1909.

Statistics show that during the last decade covered by the United States Census, the State of Oregon has grown and prospered industrially, when gauged by the usual indices of prosperity such as the increase in the number of wage-earners, the number of industrial establishments, the gross value of products, the total wages paid, etc.*

Other statistics show that during the same period of time the hours of labor in the typical industries of Oregon have declined. In 1909, 93.7 per cent. of the workers were employed less than ten hours in one day. Only 6.3 per cent. were employed in excess of the ten hours set in the law, the constitutionality of which is challenged.

No direct connection can be asserted between this growth of prosperity in Oregon and a decline in the hours

* Twelfth Census of the United States taken in the year 1900. Volume VII. 1902. Manufactures, Part I. Section XL. Limitations upon the Use of Census Statistics. The census statistics of manufactures are useful in determining the relative importance of states, cities and other communities in manufacturing, together with their relative growth in this branch of production. They are also useful in determining the progress made in different branches of manufacturing in the country as a whole and in its various subdivisions. The comparative tables, as presented in the censuses of 1880, 1890, and 1900, enable the rate of growth to be determined in all these instances with a degree of accuracy sufficient for all practical purposes. . . . They make it possible to ascertain the gross value of manufactured products, the average number of persons employed, and the total amount paid in wages at the several periods; with sufficient accuracy to be of value in economic and sociological discussions. They show the general industrial condition of the country at the time of census taking, reflecting both national and local prosperity or depression, and to this extent they can be safely used as a basis for legislative and administrative action. (Page ccxiv.)

1.—Profits of Manufacturing.—At the censuses of 1890 and 1900 the Census Office has attempted to obtain a full account of the more important items which together make up the cost of the products; but there still remain many items of expense of which it is impossible to obtain a record, and for this and for other reasons the census figures throw no light whatever upon the profits of manufacturing or upon the relative shares of the increment from manufacturing which fall to capital and to labor respectively. (Page ccxiv.)

of labor; no statistics exist which make it possible either to prove or to controvert such a connection. But it is obviously significant that the act should do no more than make compulsory a schedule of hours which the great majority of employers have already adopted of their own accord. It is also significant that the remarkable development of Oregon's industrial prosperity should have coincided with the establishment, probably gradual and sporadic, but now almost universal of a Ten Hour Day.

Table I shows the growth of industry in Oregon during the decade 1899-1909.

TABLE I.
Census of 1910. Vol. IX.
(NOTE.—Columns 3-7 are in the thousands of dollars).

Nature of Industry	Date	Number Establishments	Number Wage Earners	Capital Invested	Wages Paid	Cost of Materials Used	Value of Product	Per Cent. Increase	Value added by Mfgt.	Per Cent. Increase
All industries	1899	1406	14459	28359	6822	20789	36593		15804	
	1909	2246	28750	89082	19902	50552	93005	154.1	42453	168.6
Bakeries	1899	53	243	288	106	465	779		314	
	1909	151	613	1609	441	1621	2829	263.2	1208	284.7
Canning	1899	45	791	2708	244	1298	1994		696	
	1909	71	661	4162	315	2187	3207	60.8	1020	46.5
Car construction	1899	14	751	726	495	484	1026		542	
	1909	8	777	1400	544	509	1163	13.3	654	20.6
Flour mills	1899	105	420	3001	239	5180	6136		956	
	1909	114	394	5670	278	7667	8891	44.9	1224	28.0
Foundries	1899	45	401	993	230	328	848		520	
	1909	82	1055	3670	892	1472	3135	269.6	1663	269.8
Lumber	1899	419	6056	6948	2887	5191	11081		5890	
	1909	713	15066	35031	10172	12413	30200	172.5	17787	201.9
Printing	1899	207	840	1675	400	374	1494		1120	
	1909	324	1459	3457	1448	1103	5041	237.4	3938	251.6
Slaughtering	1899	9	172	760	88	1359	1638		279	
	1909	14	366	2481	280	5015	5880	258.9	865	210.0

(Page 1032)

The results of Table I can be shown differently by giving the average worth (1) of total production per wage-earner in each of the industries and (2) the value added per worker to the new material with which he is provided. This is shown in Table II.

TABLE II.
Increases per Worker.

Industry	Date	Total value of output per worker in dollars	Increase	Total value added to material per worker	Increase
All industries....	1899	2530.8		1093	
	1909	3234.9	704.1	1476.6	383.6
Bakeries	1899	3205.7		1292.1	
	1909	4615.0	1409.3	1970.6	678.5
Canning	1899	2520.8		879.9	
	1909	4851.7	2330.9	1543.1	663.2
Car construction	1899	1366.2		721.7	
	1909	1496.8	130.6	841.7	120.0
Flour mills.....	1899	14609.5		2276.0	
	1909	22565.9	7956.4	3106.6	830.6
Foundries	1899	2114.7		1297.0	
	1909	2971.5	856.8	1576.0	279.0
Lumber	1899	1829.7		972.6	
	1909	2004.5	174.8	1180.6	208.0
Printing	1899	1778.6		1333.4	
	1909	3455.3	1676.7	2329.0	995.6
Slaughtering	1899	9523.3		1622.0	
	1909	16065.5	6542.2	2363.3	741.3

All these industries show substantial increases. It is of importance to read these figures in connection with the distribution of the hours of labor for the same period. This is given for 1909 in Table III.

TABLE III.
Average Hours of Labor.
Census of 1909. Vol. IX.

Industry	48 & less	48-54	54	54-60	60	60-72	72	72 & over
Lumber	360	105	243	186	13766	393		13
Bakery	50	31	108	221	161	32	6	4
Flour mill	7		11		280	15	80	1
Slaughtering					340	5	5	16
Printing	1188	81	166	7	13	4		
Canning	15	28	134		280	172	1	31
Foundry	36	122	802	17	78			
Car construction..	19		697		21	40		
All industries	3396	762	3880	1030	17861	1485	194	142

(Page 1024.)

Thus out of 28,750 workers in Oregon, 1,821 or 6.3% work more than the ten hours. In the lumber industry of 15,066 workers, only 406 or 0.03% work more than 10 hours.

Table IV gives the hours per week worked in the staple industry of the State—the lumber industry.

TABLE IV.
Average Hours per week in the Lumber Industry.
Bulletin of the United States Bureau of Labor Statistics,
No. 129.

Class of labor	1907	1910	1911	1912
Carriage men		59.9	59.8	
Diggers			59.9	59.9
Edgermen		59.9	59.9	59.9
Laborers	59.8	59.8	59.8	59.9
Planer feeders			59.9	59.9
Sawyers (band)		59.9	59.9	59.9
Sawyers (circular)		59.8	59.8	59.8
Sawyers (resaw)			59.9	59.9
Setters			59.9	59.9
Trimmers		59.9	59.9	59.9

(Pages 59-70.)

Table V gives the movement of industry to cities in 1909 as compared with 1899.

TABLE V.
Census of 1909. Vol. IX.
Increase of Population in Cities.

Date.	Population.	Population in cities 10,000 and over.	Outside of cities.
1899.....	413,536	90,426	321,110
1909.....	672,765	221,308	451,457

(Page 1024.)

Table VI gives the statistics of production in cities over 10,000 and outside of cities. The increases are due to the growth of Portland and Salem.

TABLE VI.
Production in Cities and Outside of Cities.

Date.	Value in dollars of production in cities.	Value in dollars of production outside cities.
1899.....	16,903,707	19,689,007
1909.....	49,068,798	43,936,047

III. PROGRESS OF SHORTER HOURS IN 1916.

The Shorter Work Day. DOROTHY KIRCHWEY BROWN.
The Survey, January 6, 1917.

"ARMS PLANT CUTS HOURS.

Berlin Factory Puts 4,000 Women Workers on 8-Hour Day.

The Hague, July 10 (via London).—The Berlin Arms Manufactory has reduced the work of its 4,000 women employes to eight hours daily. The *Vorwärts* urges that all similar establishments follow its example, as long hours, combined with underfeeding, are proving most injurious to the women."

So runs a note in the *New York Times* of last July. Even under the pressure of war a German arms factory reduces the hours of its workers to eight a day. The tendency of the time is too potent to be altogether checked. And it is safe to assume that when hours are shortened in a munitions factory of a belligerent country, it is not mere sentimentalism that is at work.

To what extent is the United States showing this same tendency—this conviction that shorter hours are good policy? In April of this year a report was made in the *Survey* showing the progress that had been made toward shorter working hours in the United States in 1915. This article concludes by stating that "in the last ten months nearly 100,000 men and women have won the eight-hour day." The following pages will show how the promise of the year 1915 has been carried out in 1916.

Information has been obtained from state bureaus of labor, from chambers of commerce, from trade unions, from individual firms, and the net result is a realization of the nation-wide sweep of the movement to shorten working hours and to penalize long hours by treating them as overtime. This movement is shown in cases where unions are powerful and have forced concessions from employers; it is shown in partly organized trades where employers have granted shorter hours to forestall demands already imminent; it is shown quite as markedly in the numerous cases where the employes, though not organized at all, have been given shorter hours through the entirely voluntary action of their employers. Comprehensive statistics are not obtainable on this subject; records are kept of current events by only a few of the state statistical bureaus; trade union memberships vary from day to day, so that it is almost impossible

to report definitely how many men were affected by the shorter hours.

The best figures we have, however, come from the annual report of the executive council of the American Federation of Labor, issued November 13, 1916, and dealing with the twelve months from September, 1915, to September, 1916.* Thirty-five of the national and international unions directly affiliated with the American Federation of Labor report a reduction in hours for part or all of their members. Many others report that organized members of their trades work shorter hours than unorganized ones, and report also a large increase in membership, which, of course, implies shorter hours for the new members. A careful study of the figures in the reports of these national and international unions shows that approximately 400,000 of their members had their hours of work reduced during the year. This does not include the potential reduction of hours of the four great railroad brotherhoods by the Adamson Law, but does include the 150,000 anthracite coal miners whose hours were shortened April 1, 1916, by the agreement between the coal operators and the United Mine Workers of America. Aside from the miners, a conservative estimate gives us some 200,000 of the most highly organized workers in this country whose hours have been reduced in the past year—to say nothing of those who are not organized or whose unions are not affiliated with the American Federation of Labor, who would greatly increase the total. The amount of the decrease ranged from the one hour a week gained by some 80,000 members of the Ladies' Garment Workers' Union, whose weekly hours were reduced from fifty to forty-nine, to the twenty-four hours a week of the 880 Stationary Firemen whose working day was changed from twelve to eight hours.

The workers who benefited most from reduced hours were the teamsters with an increase in membership of nearly 7,000; the garment workers and tailors; the textile workers, 70,000 of whom secured the fifty-hour week; the paper-makers and the pulp, sulphite and paper mill workers whose hours were reduced from twelve to eight and the electrical workers, lathers, metal polishers and machinists. Forty thousand of the last named now enjoy the eight-hour day; 10,000 have gained it since January 1, 1916.

* Report of the Executive Council of the American Federation of Labor to the Thirty-sixth Annual Convention, pp. 16-33.

Benefits for Other Union Men.

Among the other national and international unions which report shortened hours are the bakers, boot and shoe workers, railway carmen, carriage and wagon workers, wood carvers, railway clerks, diamond workers, cloth hat and cap makers, laundry workers, lithographers, pattern makers, powder and high explosive workers and tobacco workers.

Our figures have so far not taken into account the twenty-odd local unions directly affiliated with the American Federation of Labor (not affiliated through a national or international union), which report shortened hours. These include workers in trades of all sorts, and in all parts of the United States, from an Agricultural Workers' Union in Cabo-Rojo, Porto Rico, to a Union of Janitors in Minneapolis.*

Correspondance with union officials and supplementary items from the Federationist show that about 60,000 additional workers in many scattered unions have secured reductions ranging from four to one hour per week.†

* Others included are flour and cereal mill workers in Illinois and Wisconsin; last makers in Salem, Mass.; tin, steel, iron and granite ware workers in Illinois; cooks and waiters in Tampa, Florida, and others as diverse in kind and location.

† Union	No. of Men Affected	No. of Hours Reduced	Present Hours
International Brotherhood of Electrical Workers	800	4	44
International Brotherhood of Electrical Workers	3,500	4	50
International Hod Carriers, Building & Common Laborers.....	984	$\frac{1}{2}$	---
Granite Cutters	6,000	1	44
International Brotherhood Teamsters & Chauffeurs	30,000	1	---
United Brotherhood Carpenters & Joiners	700	1	8
International Fur Workers of United States and Canada.....	2,500	5	---
Wood Carvers (Furniture Shops)	---	3	48
Laundry Workers	300	1	9
Quarry Workers	200	4	---
Bakery & Confectionery Workers.....	1,700	---	---
Amalgamated Lace Operatives.....	500	1	9
Stove Mounters	400	1	9
International Photo Engravers.....	---	6	42
International Typographers	all classes	5.5 (average)	---
Brotherhood of Painters, Decorators & Paper Hangers.....	3,437	---	8 9
Window Cleaners (Cleveland).....	---	1	9

So much for information from trade unions. Much that is useful has also come from state officials. Perhaps the most interesting case reported to us is that of the *Mill Workers of Denver v. the Mill Owners of Denver, et al.*, a decision on which was made by the Colorado Industrial Commission in November, 1916. The mill workers had applied for an eight-hour day and for an increase in wages, on the ground that the price of living had increased while wages had remained stationary, that the mill workers of Denver were paid "far below any other city in this state or any of the states," and that the wood-working mills of Denver were all making a profit and were able to pay higher wages. The mill owners categorically denied these claims, with the exception of the statement as to the increased cost of living. The commission disallowed the wage increase, but rendered an unusually valuable opinion on the eight-hour day. The commission says:

"The mill workers are now working under a nine-hour day and have asked for an eight-hour day, with time and a half for overtime. This demand has not been seriously contested by the mill owners, and we believe, cannot be. They have suggested that it will be impossible for a worker to do as much in eight hours as in nine hours, and while as a matter of physical exertion and of mathematics, this may be true, under certain circumstances, we believe it is not permanently true. We believe that the eight-hour day could and should be granted to the men under the following conditions: For the first six months, beginning with the promulgation of this opinion, the workers in the mills of Denver be granted an eight-and-one-half-hour day, with the same pay that they now receive for a nine-hour day, and at the end of that time they be granted an eight-hour day with the same pay they now receive for a nine-hour day. We believe that with a gradual approach in this manner the quantity of the product which the mills of Denver produce will not be lessened very materially, and that it is even possible that it may be increased. This would amount to an increase of wages of $12\frac{1}{2}$ per cent. over the present scale, which would be a substantial increase in wages to the mill workers of this city. The Commission has heretofore declared for an eight-hour day, and so holds in this

case. We base this upon the tendency of the times, upon the experience which we have observed in those places where an eight-hour day has been heretofore granted. It has been shown in the evidence and to our satisfaction in the experience of many plants that

“(1) The improved machinery which is such a marked characteristic of our age in all lines of mechanics is an additional reason why men should be given a shorter work day. . . .

“(2) There is a natural tendency to slow up under a ten-hour system, and a natural tendency to speed up under an eight-hour system.

“(3) That a long work day lowers the vitality and increases the fatigue of the worker and gradually slows up his work and diminishes the amount of his product. . . .

“(5) The experience which the Industrial Commission has had and the observations which it had made in those shops where a reduction has been made from a nine to an eight-hour day, has not, in any case, shown a decrease in the amount of product turned out.

“It is, therefore, the opinion of the Industrial Commission that it is altogether possible and practicable for the eight-hour system to be worked out successfully in this industry, amounting to an increase in wages of 12½ per cent. . . .”

Scope of the Inquiry.

To find out in greater detail what the motives have been which have brought about the shortening of hours by employers where there have been no strikes and where as far as we know there has been no great union pressure brought to bear, letters of inquiry were sent to practically every firm which was reported to us as having shortened its hours in the past year. A large number of courteous and useful answers were received. Most of them fall roughly into one of these groups: paper and pulp mills, oil refineries, metal and mechanical establishments and leather and shoe factories, with one or two from textile mills.

The paper mills of the United States have this year introduced an eight-hour shift literally “from Maine to California.” This has been due to the fact that in this

trade, mills are operated continuously twenty-four hours a day for six days in the week, and that the growing influence of trade unions in the industry, as well as the more enlightened opinion among manufacturers has been turned against the two shifts of twelve hours each or the eleven and thirteen-hour shifts which formerly were the rule. A large group of paper mills in Wisconsin, and others in Hamilton, Ohio, and Michigan, have recently introduced the change to eight hours. Oil refineries all over the United States have reduced hours to eight within the past year.* Various factories making one variety or another of metal goods have recently shortened their hours. In the last two months three large shoe and leather factories, two in New England and one in New York, have established the eight-hour day.

Attitude of Employers.

Of the employers some have merely yielded to the inevitable, apparently considering, as one of them said, that "the eight-hour day has arrived." But certainly with many the change has expressed the real conviction that shorter hours mean increased efficiency and a wiser business policy.

Of those who yielded to the movement, though unconvinced of its complete wisdom, a prominent company of Kalamazoo, employing twelve hundred people, writes:

"We would frankly state that, while the system is not entirely satisfactory as far as the efficiency of our plant is concerned, it seems to be in keeping with the times and age."

Similarly the American Steam Pump Company of Battle Creek, Mich., said: "We do not believe in the eight-hour day with ten hours' pay," but with a nine-hour day, they report, "Our experience in this matter has been quite satisfactory."

The Timken-Detroit Axle Company, while expressing doubts of the "straight eight-hour day," has successfully introduced the fifty-four-hour week, affecting four thousand men. And the big Chicago plant of the International Harvester Company reduced its hours from fifty-five to fifty a week, thus shortening the work-day for the

* For example, in Texas, the Texas, the Gulf and Magnolia companies, employing about 6,000 men.

largest number of employes (15,000) in any one firm reported on.

A more radical change in hours introduced with a stronger conviction of its benefit to both employers and employes, was reported by the Northwestern Steel Company of Portland, Oregon, whose president wrote: "Our reasons were simply that the time has come for the eight-hour day, and it is long enough for anyone to work." Other firms expressing a similar belief in the justice of the eight-hour day were a Wisconsin paper manufacturer and the Dale Lighting Fixture Company of New York City.

"As to our opinion as to results," writes the former, "we cannot see that we have obtained any better service, but are satisfied that it is better for the men, and we believe that where factories are in operation twenty-four hours continually it is no more than right that the men should have the eight-hour shift."

"We adopted the eight-hour day," said John H. Dale, "because we believe it is the right thing to do by our men. We expect those two hours a day to benefit our people greatly and to pay us good dividends in increased good will and efficiency. Those who oppose the new spirit that is springing up between employers and employes will soon find the results of their futile opposition recorded on the wrong side of their ledger."

More important still, the Standard Oil Company of California, following the previous action of the Standard Oil Companies of Indiana and New Jersey (10,000 men affected), announced that all their refinery, pipe line and producing department employes were to be put on an eight-hour day, and wrote of this change benefiting between 7,000 and 8,000 men:

"The action of the directors of our company relative to the eight-hour day was taken for the reason that they believed it the right thing to do for the men in our employ, and was acted upon without any request or suggestions having been made by any of our employes."

Efficiency as well as justice was prominent among the motives leading employers to adopt shorter hours. The Ford Motor Company, with its 30,000 employes, bears telling testimony to the effect of the eight-hour day in practice:

"The improvements noticed among our men in the way of increased efficiency, increased production, better habits of citizenship and thrift, may be jointly attributed to the reduction of nine to eight hours per day and also the profit-sharing plan and other minor welfare features, and cannot be attributed to any one of them in particular. We do, however, feel that the eight hours per day has particularly predominated the increased production, degree of efficiency and the reduction in labor turn-over. It is our candid opinion that working year in and year out a man can do more in eight hours per day than in a larger number."

Among shoe manufacturers a large and well-known New England firm—the W. H. McElwain Co.—introduced the eight-hour day in December, 1916, affecting between 6,000 and 7,000 employes, with the brief comment: "It was felt by the directors to be wise business policy."

Practically all these changes took place without reduction of wages.

No more striking example of the employers' new attitude toward the eight-hour day can be found than a letter from George F. Johnson of Endicott, Johnson & Co., of Endicott, New York, the largest makers of leather shoes in the world. Twelve thousand employes affected by this reduction to eight hours on November 1, 1916, held a great eight-hour parade in celebration.

A Shoe Manufacturer's Testimony.

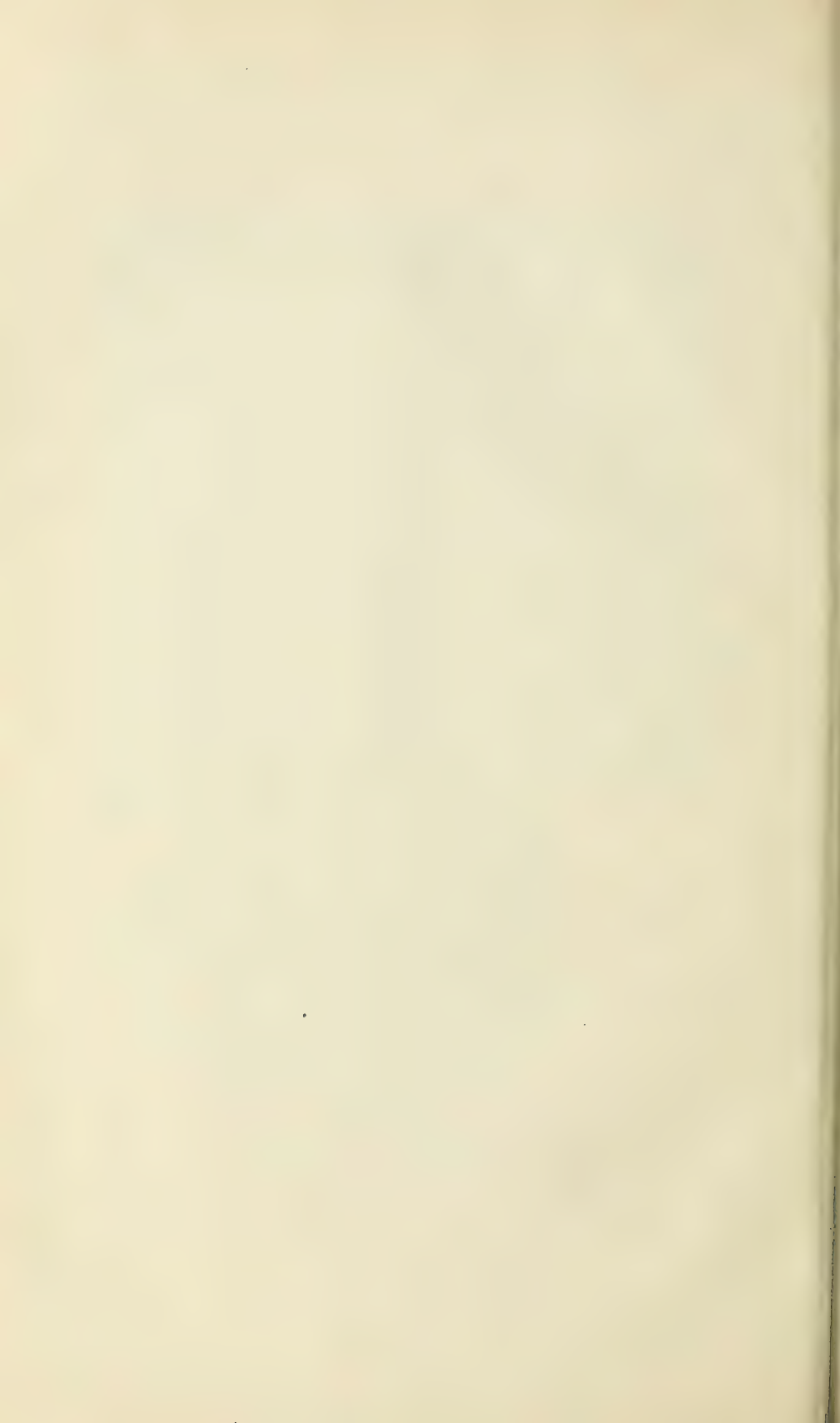
Mr. Johnson writes: "Our purpose in establishing the eight-hour day was to make proper recognition of the fact that, in a prosperous business like ours, the more people participating in the prosperity, the greater the benefit of same. As our business has grown and prospered, we have recognized this principle: All of the workers should share in the prosperity.

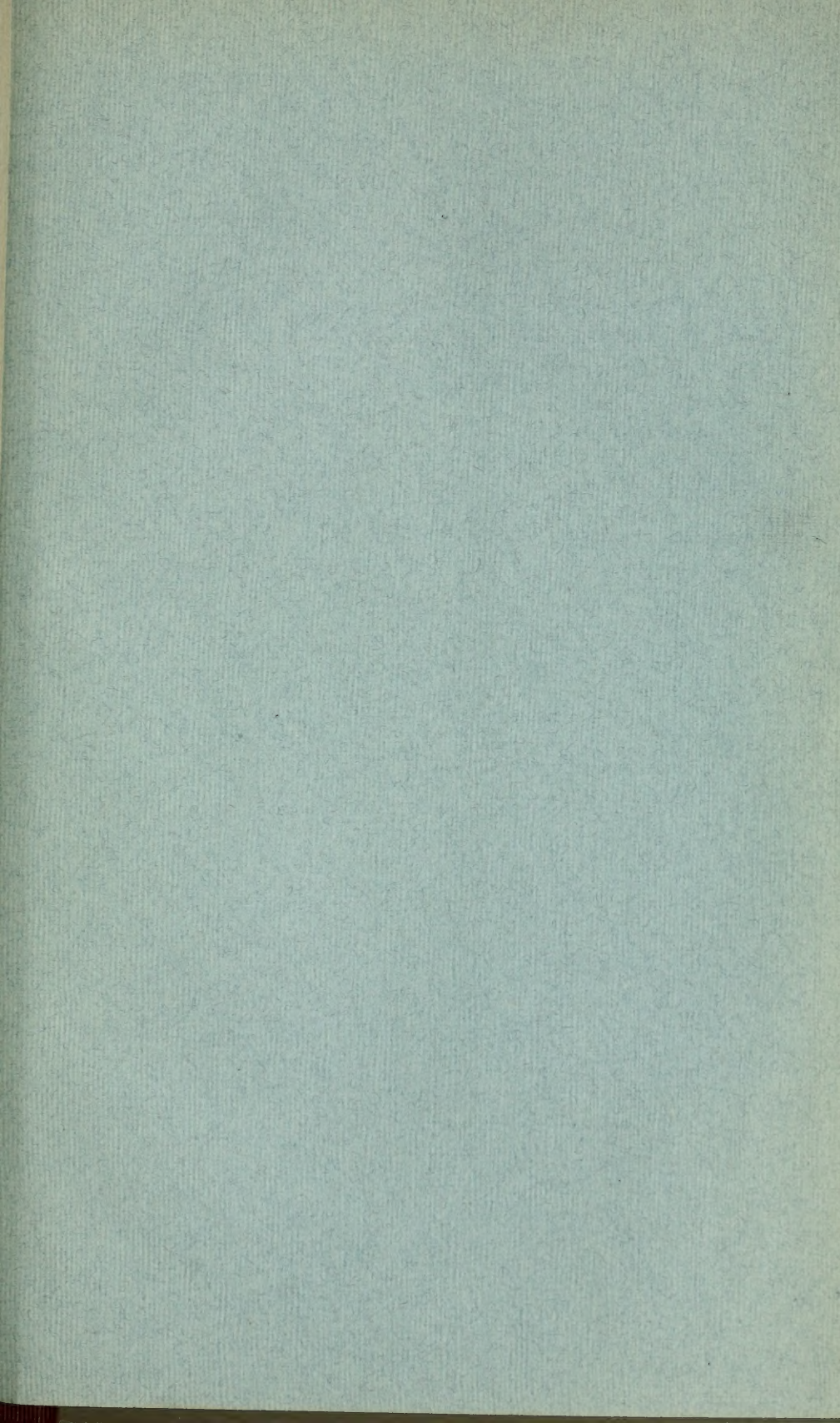
"We have no theories about the eight-hour day. Never have had. We think the eight-hour day has 'arrived.' We think it is a mistake for employers of labor to dispute it. We agree with the President, 'Society has set its seal of approval upon the eight-hour day.' The sooner it is recognized, universally (so far as possible), the better for all concerned, and the sooner the proper adjustment can be made.

“So far as we are concerned, it was the greatest pleasure in our lives to grant the eight-hour day voluntarily, without reduction in wage, and we sincerely hope that it may be made possible for us to still further improve, constantly, the working conditions, and the wage of all our working partners.

“Finally, to sum up, it was simply our honest desire to improve conditions and increase the wage of the people in our employ, just as fast as we feel safe in doing it. Meaning, of course, that we must meet competitive conditions, and safeguard the business always. What it is possible for a concern to do, who are non-competitive, may not be possible for us to do; but we shall, as above stated, keep constantly before us the wish and the fervent hope that we may improve conditions for all, with a proper regard for the rights of the consumer.”

There indeed is the new spirit in industry. It sums up a feeling of which one catches glimpses in many industries and many states from the Atlantic to the Pacific. It gives in more detail the general principle already quoted from the letter of the Northwestern Steel Company of Portland, Oregon, “The time has come for the eight-hour day, and it is long enough for anyone to work.”





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County in the state of Kentucky

+ Howard, Edward

+ Johnson, Lewis

+ Smith, Thomas

+ Taylor, John

+ Weaver, Robert

+ Williams, George

+ Williams, Joseph

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Not accessioned.

Author Frankfurter, Felix and Goldmark, J.C.

Title The case for the shorter work day.
Supplemental brief for defendant in error upon

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